The Lemonade Cart · Visual Braille · Testing for Teachers

$2.00

Personal Computing

NOVEMBER/DECEMBER, 1977

INTELLIGENT VIDEO GAMES ARE HERE

is to take it apart piece by piece.

Compare the features of our S-100 bus system, the industry standard, to anyone else. After you've taken them apart piece by piece, you'll know why IMSAI is the system you can grow with. At a price you can live with.

IMSAI 80/30 Integrated Video Computer (with Intelligent Keyboard—IKB-1) Standard Features:

□ **Price assembled $1499.** IMSAI is the only S-100 bus manufacturer that offers a microprocessor driven keyboard with "N" key roll over, 2¼K of RAM, 8 expansion slots, choice of 4K, 16K, 32K and 64K RAM expansion boards, 3K ROM monitor, synch/asynch serial interfaces, parallel and serial ports, high resolution CRT monitor, 24 x 80 display with graphic editing and data entry features, and 28 amp power supply for the incredibly low price of $1499.

□ **mpu Speed.** IMSAI is the only S-100 bus manufacturer that offers true 8080 compatibility, operating at 3 mHz.

□ **RAM Included.** 2¼K.

□ **Expansion Slots.** Eight expansion slots are provided in a new terminated and regulated motherboard (10 slots total).

□ **RAM Board Sizes.** IMSAI is the only S-100 bus manufacturer to supply 4K, 16K, 32K, and 64K RAM memory expansion boards.

□ **ROM Monitor.** IMSAI is the only S-100 bus manufacturer to provide 3K of ROM.

□ **Asynch/Synch.** Only one other S-100 bus manufacturer provides both methods of data communication.

□ **PIO/SIO.** IMSAI is the only S-100 bus manufacturer that provides two serial ports and one fully implemented parallel port at no extra charge.

□ **Video I/O.** IMSAI is the only S-100 bus manufacturer to include a high resolution (14 mHz) monitor as an integrated part of the computer.

□ **CRT Format.** IMSAI is the only S-100 bus manufacturer to provide a full 24 x 80 screen, which is two times the capacity of the common 16 x 64 screen.

□ **Graphic/Edit.** IMSAI is the only S-100 bus manufacturer that provides graphics and text editing features with character and line insert/delete for your CRT display.

□ **Keyboard Included.** IMSAI is the only S-100 bus manufacturer to supply a microprocessor driven keyboard with "N" key roll over and tiered construction for a true typewriter keyboard touch.

□ **28 amp Power Supply.** The world famous IMSAI power supply assures stability and reliability of performance.

Options: IMSAI is the only S-100 bus manufacturer to provide a comprehensive array of fully integrated options including: line and character printers, CRT terminals, intelligent keyboard, ACR storage, standard and mini floppies, TTY BASIC with OS, 4K, 8K and 12K BASIC, audio cassette BASIC with OS, 8K disk operating system (DOS) based upon CP/M,* scientifically and commercially oriented disc BASIC and level 2 FORTRAN IV compiler.

□ **Printers.** Only one other S-100 bus manufacturer can supply both line and character printers.

□ **CRT/Keyboard.** IMSAI is the only S-100 bus manufacturer to provide both CRT terminal and intelligent keyboard as separate options.

□ **ACR Storage.** Available.

□ **Floppies.** IMSAI is one of the few S-100 bus manufacturers to provide both standard and mini floppies and the only S-100 bus manufacturer that supplies double density standard floppies.

□ **TTY BASIC.** IMSAI is one of the few S-100 bus manufacturers that provides self-contained operating systems with 4K, 8K and 12K BASIC.

□ **ACR BASIC.** IMSAI supports ACR BASIC with an 8K version.

□ **DOS.** IMSAI is the only S-100 bus manufacturer to provide an enhanced version of the control program monitor (CP/M*) that can support up to 18 disk drives.

□ **Disc BASIC.** IMSAI is the only S-100 bus manufacturer that provides both scientific and commercial versions of compiler oriented BASIC.

□ **FORTRAN IV.** IMSAI is the only S-100 bus manufacturer that offers a level 2 FORTRAN IV compiler that operates under an enhanced version of CP/M.*

Prices and specifications subject to change without notice.
*CP/M is a trademark of Digital Research Corporation.

Price/Performance no one else has put together.

CIRCLE 1

IMSAI®

the best way to build your system...

PCS-80/30 Integrated Video Computer

PCS-80/15 (w/IKB-1)

PCS-80/30; 80-25A, DHMO

PCS-80/ Components

IMSAI introduces the PCS-80 component system...

The $6,000* DP Center.

IMSAI Introduces the VDP-80

Until now, owning real computing power meant paying unreal prices. Announcing the IMSAI VDP-80 Video Data Processor, a complete computer, intelligent terminal and megabyte floppy disk mass storage system. All in one compact cabinet. All for just **$5995**.* A complete desk top DP center.

For small business applications, the VDP-80 places a stand-alone computer at your fingertips. And, our full line of add-on peripherals, assures that the system can be expanded as your needs do.

For the large business user, with an existing central mainframe, the VDP-80 is the ultimate remote processor. You have the advantage of powerful local processing capability, plus the epitome in cost-effectiveness for implementing a distributed data communications network.

Take a close look at the following features. Then you'll know why we call our VDP-80 the desk top DP center.

☐ **Powerful, High-Speed, Central Processor.** 3 mHz Intel 8085 microprocessor. 32K RAM memory (expandable to 196K). Parallel and serial I/O. Asynch, synch and bisynch communications. Programmable baud rates (.05-56 KB).

☐ **Megabyte Mass Storage.** PerSci dual floppy, double density disk drive standard. One million byte storage capacity. Three floppy disk drives can be added-on, providing 4 million bytes of on-line storage.

☐ **Drives Printers, Plotters, Terminals, Modems and Tape Drives.** Supports up to six terminals or modems, and four tape drives. Drives plotters, serial printers and line printers (up to 300 lpm).

☐ **12" CRT, 24x80 Field, User Programmable Font.** Character and line insert/delete allows fast program correction and text editing. Inverse video and programmable field allows highlighting or enlarging graphics of information display. Titled fields protect information blocks from being written over accidentally. Programmable font (up to 256 different characters) allows foreign language and special purpose character forms.

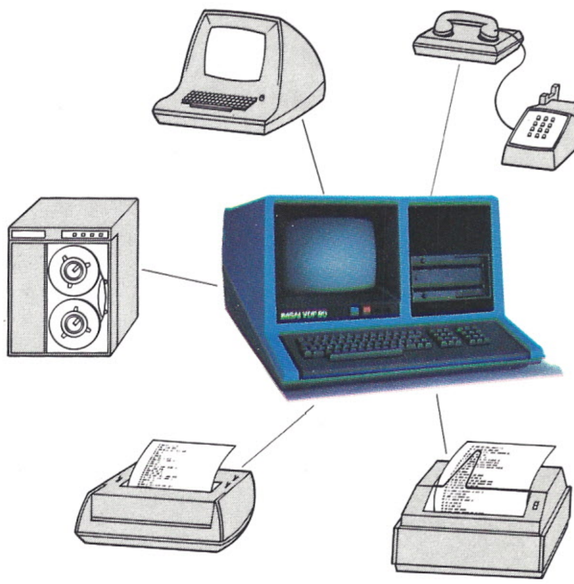
☐ **Alphanumeric Intelligent Keyboard.** 62-pad main keyboard. Programmable 12-pad numeric keyboard. 12-pad control keyboard. Standard typewriter and calculator keyboard layouts. "N" key roll over reduces operator error during high-speed data entry.

☐ **Commercial BASIC, FORTRAN IV, DOS Software.** Built-in ROM monitor allows extensive debugging and diagnostics. BASIC, interactive or compiler version. FORTRAN IV level 2 ANSI compiler. DOS-enhanced CP/M.**

Distributed processing, financial reporting and analysis, word processing, whatever your application, the VDP-80 is your answer.

Dial (415) 483-2093, and we'll tell you how you can put our $5995* DP Center on your desk top. When it comes to small business computers, Just Ask IMSAI.

*Base price VDP-80/1000, $5995, with 32K RAM memory and dual double density floppy disk drive. U.S. Domestic Price Only. Features and prices subject to change without notice.
**CP/M is a trademark of Digital Research Corporation.



IMSAI®

The Standard of Excellence in Microcomputer Systems

IMSAI Manufacturing Corporation
14860 Wicks Blvd.
San Leandro, CA 94577
(415) 483-2093   TWX 910-366-7287

You can now have the industry's finest microcomputer with that all-important disk drive

The professional-grade microcomputer for professionals

Shown with optional bench cabinet

YOU CAN GET THAT ALL-IMPORTANT SOFTWARE, TOO

Loading your programs and files will take you only a few seconds with the new Cromemco Z-2D computer.

You can load fast because the Z-2D comes equipped with a 5″ floppy disk drive and controller. Each diskette will store up to 92 kilobytes.

Diskettes will also store your programs inexpensively—much more so than with ROMs. And ever so much more conveniently than with cassettes or paper tape.

The Z-2D itself is our fast, rugged, professional-grade Z-2 computer equipped with disk drive and controller. You can get the Z-2D with either single or dual drives (dual shown in photo).

CROMEMCO HAS THE SOFTWARE

You can rely on this: Cromemco is committed to supplying quality software support.

For example, here's what's now available for our Z-2D users:

CROMEMCO FORTRAN IV COMPILER: a well-developed and powerful FORTRAN that's ideal for scientific use. Produces optimized, relocatable Z-80 object code.

CROMEMCO 16K DISK BASIC: a powerful pre-compiling interpreter with 14-digit precision and powerful I/O handling capabilities. Particularly suited to business applications.

CROMEMCO Z-80 ASSEMBLER: a macro-assembler that produces relocatable object code. Uses standard Z-80 mnemonics.

ADVANCED CONTROLLER CARD

The new Z-2D is a professional system that gives you professional performance.

In the Z-2D you get our well-known 4-MHz CPU card, the proven Z-2 chassis with 21-slot motherboard and 30-amp power supply that can handle 21 cards and dual floppy drives with ease.

Then there's our new disk controller card with special features:

- Capability to handle up to 4 disk drives
- A disk bootstrap Monitor in a 1K 2708 PROM
- An RS-232 serial interface for interfacing your CRT terminal or teletype
- LSI disk controller circuitry

Z-2 USERS:
Your Z-2 was designed with the future in mind. It can be easily retrofitted with everything needed to convert to a Z-2D. Only \$935 kit; or \$1135 for assembled retrofit package.

We're able to put all of this including a UART for the CRT interface on just one card because we've taken the forward step of using LSI controller circuitry.

STORE/FACTORY

Contact your computer store or Cromemco factory now about the Z-2D. It's a real workhorse that you can put to professional or OEM use now.

Kit: Z-2D with 1 disk drive (Model Z2D-K) .... \$1495.
Assembled: Z-2D fully assembled and tested (Model Z2D-W).... \$2095.
Additional disk drive (Model Z2D-FDD) .... \$495.

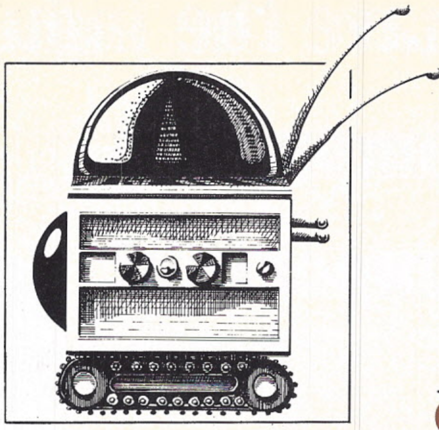
SOFTWARE

(On standard IBM-format soft-sectored mini diskettes)
16K BASIC (Model FDB-S)......... \$95
FORTRAN IV (Model FDF-S)........ \$95
Z-80 Assembler (Model FDA-S).... \$95

Cromemco
incorporated
Specialists in computers and peripherals
2400 CHARLESTON RD., MOUNTAIN VIEW, CA 94043 • (415) 964-7400

CIRCLE 4

27

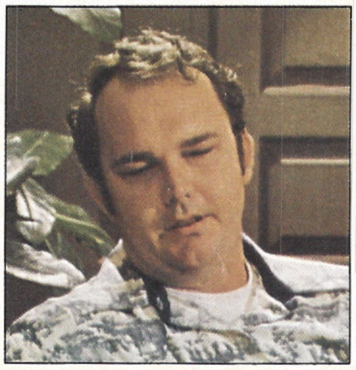


What will this guy look like in 30 years?

42

Up the ante: playing craps with your computer

57



A personal computing pioneer looks back.

71

Can the computer remedy hotel madness?

SUBSCRIPTION POLICY

Subscription rates: Six issues – U.S., $8; Canada and Mexico add $2 for surface mail and $4 for airmail; all other countries add $4 for surface mail and $18 for airmail. Twelve issues – U.S., $14; outside U.S., postage rates doubled. Back issues (as available): $2 per copy in U.S.; $4 in Canada and Mexico; $5 in all other countries. Send subscription orders and changes of address to: Circulation, Personal Computing, 1050 Commonwealth Ave., Boston, MA 02215.

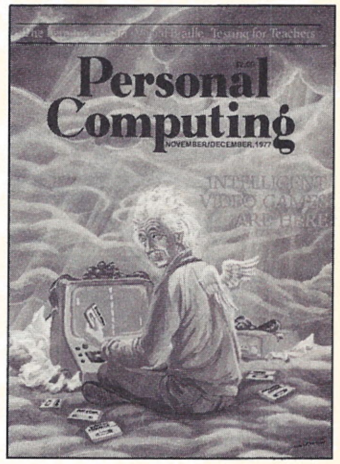
Personal Computing is published bimonthly by Benwill Publishing Corp., 1050 Commonwealth Ave., Boston, MA 02215; telephone (617) 232-5470. Publishing Office: 1050 Commonwealth Ave., Boston, MA 02215; telephone (617) 232-5470. Controlled circulation postage paid at Long Prairie, MN. Membership application in Audit Bureau of Circulation pending.

CONTENTS

Personal Computing

NOVEMBER/DECEMBER 1977 VOL. 1 NO. 6

COVER



Up in the clouds with video games? Ask this man for help. Illustration by Nancy Lawrence, design by Jane Higgins.

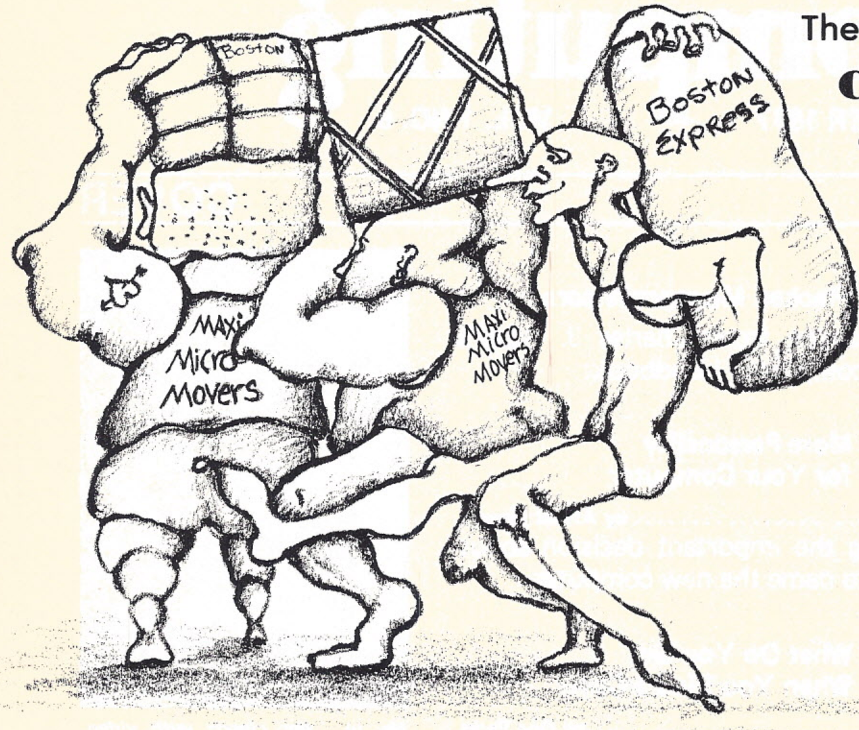
All editorial correspondence should be addressed to PERSONAL COMPUTING, 1050 Commonwealth Ave., Boston, MA 02215.

We welcome submission of manuscripts for publication and pay competitive rates for material accepted. Authors should study the magazine for content and style to avoid sending inappropriate material at expense in time and postage.

Always include a stamped, self-addressed envelope if you want material returned. PERSONAL COMPUTING takes no responsibility for the safekeeping of materials not specifically solicited but attempts to respond promptly to submissions.

STAFF

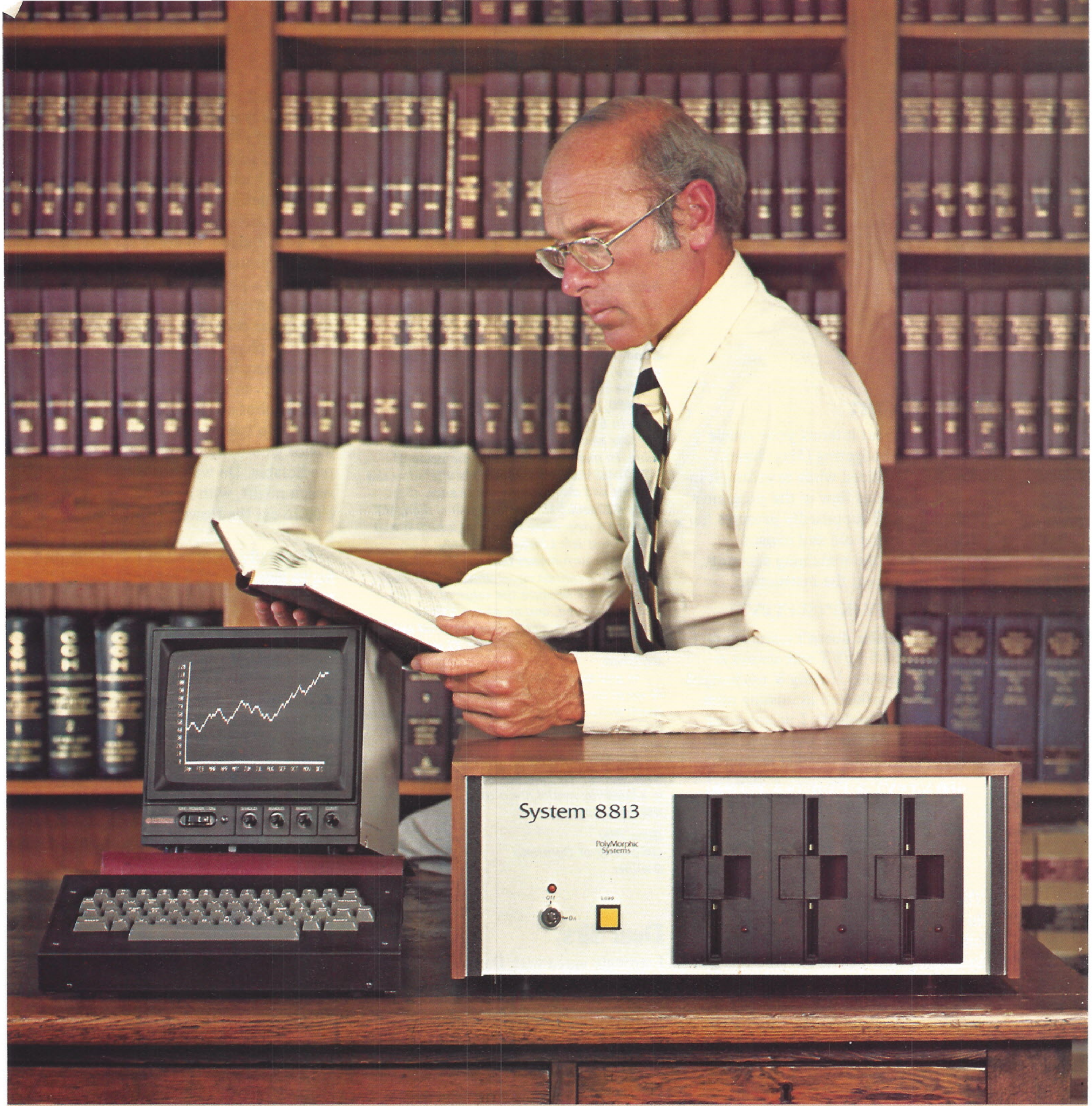
PERSONAL COMPUTING
MAKES A MOVE



The editorial offices of **PERSONAL COMPUTING** are now located at Benwill Publishing headquarters in Boston. Please send all correspondence to

PERSONAL COMPUTING,
1050 Commonwealth Avenue,
Boston, MA 02215.

To reach us by phone, call (617) 232-5470.


System 8813
PolyMorphic Systems

Letters

Dear Editor:

I read with great interest your article on recursive budgeting (May/June). However, I noticed while rewriting it into APL, a serious flaw in the program's logic. Line 48Ø supposedly prorates the difference of the old and revised amounts over the remaining accounts, but if you inspect the instruction

```
V(K)=INT(V (K)*(SI-FT)/VT)
```

you will find this doesn't occur, in fact, the factor (SI-FT)/VT will always remain as 1, thereby leaving V unchanged. (This will be reflected as missing monies in the final budget). I propose the following corrections. OA is my variable for storing the original amount.

```
48Ø VT=VT-A:FT=FT+A:F(J)=A:
    OA=V(J):V(J)=Ø
49Ø FORK=ØTOQ:V(K)=INT(V(K)
    *(SI-FT)/(VT-(OA-A))):NEXTK:
    VT=SI-FT
```

The program otherwise worked fine. In my version I have extended the capabilities by introducing a prefix letter indicating time period (W-weekly, Q-quarterly, etc.), so expenses may be entered in full amounts. In addition, the refining stage displays the original amount entered to reflect the change resulting from the proration. Users who are interested in this APL version (DEC-1Ø), can secure a listing by writing to me. No charge other than postage will be imposed.

Very truly yours,

Alex Nesenjuk
Corporate Scientific & Mathematical Services
Johnson & Johnson
Raritan, New Jersey

In response to Mr. Nesenjuk's thoughtful letter, let me state first that I cannot help but admire a person who undertakes to interpret a program written by another person. In this case the task was made more difficult because the program was tightly packed (in order to save memory). It should not be surprising then that the object of the statement in question was not understood. It will be difficult to explain, but I will try.

The statement at issue does not occur in line 480, as stated, but rather in 490, and again in 512. The loop is entered each time the user elects to change a variable expanse value. In making the change, the value of VT (Total Variable Expense) is altered in the amount and direction of the change. (See Lines 480 and 510). At this point, then, VT takes on a new value from that which it had when it last left Lines 490 or 512.

This in turn means that the expression (SI-FT)/VT cannot equal unity. SI-FT cannot equal VT because the value of a V(K) has been altered, and all of the V(K)'s summed more recently than the total available for variable expense (SI-FT) was established.

In any event, Mr. Nesenjuk and I can carry on in correspondence, then when WE reach unity, we can send a joint letter to you, hopefully in time for the next following issue.

But I cannot quarrel with success. They both worked (!), and Mr. Nesenjuk's is clearly a superior model given the bells and whistles he has added.

Gene Dial
University of Colorado
Boulder

Dear Sirs:

I strongly agree with David Heiserman that philosophical issues relating to the goals of robotics need to be discussed and developed. It is my feeling, however, that the approach he suggests runs into a number of serious problems, both theoretical and empirical. (See *What Is a Robot?*, July/August issue).

Essentially, he argues, the *sine qua non* of true robotic behavior is autonomy; the freedom to choose goals and the means to achieve them. In proposing this argument, however, he is requiring of robots a property (autonomy or free will) whose function in the explanation of human behavior is steadily diminishing. Studies in ethology and behavior analysis have demonstrated with increasing precision the powerful effects of genetic and environmental events on the determination of behavior.

Free will can be argued, but never proved, it is simply inferred from the absence of other specifiable causes of behavior. To incorporate the presence of such a vague and tenuous concept into the definition of the true robot seems to direct efforts toward an illusory goal. Indeed, to argue for the kind of autonomous behavior Heiserman describes in a physical system such as a robot is, strictly speaking, to argue for the regular occurrence of *emergent events* – physical effects without causes. Nowhere in science have such phenomena been demonstrated. Indeed, were a robot constructed whose behavior had no specifiable causes, its behavior would, by definition, be unpredictable. Do we want a machine which might, with no provocation, decide to eat the flowers off the wallpaper?

Generally then, rather than attempting to develop machines with essentially supernatural powers, it would seem more reasonable to work toward the development of increasingly sophisticated hardware and software to produce pararobots (as defined by Heiserman) capable of obeying orders, choosing the most effective means to fulfill them (based on prior programming!), modifying behavior as conditions changed and learning from experience new and more effective means of behaving. If these can be developed, what more could we need? Indeed, what more could we want?

Sincerely,

Barry Lowenkron, Ph.D.
Department of Psychology
California State University, Los Angeles

Dear Sir:

Douglas Crockford's letter on the Star Trek game (July/August issue) neatly illustrates a basic computer axiom: GIGO (Garbage In – Garbage Out). Mr. Crockford reasons that since Captain Kirk seeks, blindly and zealously, to "totally destroy" Klingons and since the Klingons are "peaceful and reasonable," therefore the game is "militaristic and sadistic." The logic is, as in a computer, precise; the premises, however, are "garbage." Predictably, so is the conclusion.

True, Kirk is ordered to do his duty which entails destroying Klingon battle cruisers. Not necessarily true, though, is that the Klingons are peaceful or reasonable, or anything else.

IS YOUR DOLLAR BUYING AS MUCH POWER & FLEXIBILITY AS TDL'S XITAN SYSTEMS PROVIDE?

OUR CUSTOMERS SAY THINGS LIKE THIS ABOUT TDL PRODUCTS:

"... the best CPU board I've put together... excellent parts... worked right off without trouble shooting." .... JRG, Cambridge, Mass.

"Great product." .... KMM, Bella Vista, Ark.

"... high quality components, good engineering & complete documentation... up and running without any problems." .... WP, Seattle, Wash.

"Excellent." .... Col. DWW, Santa Maria, Calif.

"Very impressed with superb quality." .... SK-L, Boston, Mass.

XITAN alpha 1

When we combined our highly praised ZPU board and our System Monitor Board, we defined the standard for the industry; we integrated more power and flexibility in two slots of our motherboard than most other systems can muster using five or more boards. When we put this setup into our rugged aluminum case we created the first XITAN system, the *alpha 1*. By adding a CRT terminal and/or teleprinter you will have a complete computer system.

KIT: $769 ASSEMBLED & TESTED: $1039

XITAN alpha 2

By adding a Z16 memory module and our PACKAGE A software to the *alpha 1* we created a second XITAN system, the *alpha 2*. Thus, a complete and extremely powerful micro-computer system emerges well worthy of you who are operating at the most sophisticated levels. The XITAN *alpha 2* provides you with 18K of RAM, 2K of ROM, 2 serial I/O ports, 1 parallel I/O port, our 1200 baud audio cassette interface as well as our extraordinarily powerful software package which includes 8K Basic, the Text Output Processor, the Zapple Text Editor and the Relocating Macro-Assembler. Add your own I/O device and GO...with the most powerful and flexible micro-computer package ever offered.

KIT: $1369 ASSEMBLED & TESTED: $1749

**IF YOU ARE A BEGINNER, YOU WON'T EASILY OUTGROW THE XITAN SYSTEM.
IF YOU ARE AN ADVANCED USER, YOU WILL DISCOVER XITAN IS EXACTLY WHAT YOU NEED.**

†Write for descriptive brochure on the XITAN **alpha** series and system software. When you ask at your dealer, say "ZY-TAN."

ORDERING INFORMATION: Send check, money order or BankAmericard, Master Charge current number and expiration date. Shipping is usually made via UPS or UPS Blue Label. Specify other arrangements if you wish. Prepaid orders are shipped postpaid.

TECHNICAL DESIGN LABS

RESEARCH PARK BLDG. H 1101 STATE ROAD
PRINCETON, NEW JERSEY 08540 (609) 921-0321

Letters

There are those (Mr. Crockford presumably among them) who believe that other cultures are invariably pacifist. Reality, in its perverse way of accomodating beliefs, arrogantly flouts this one, notwithstanding the earnestness of the believers. History abounds with examples of earthbound cultures that are fully rational yet are neither peaceful nor reasonable. Attila and his Huns are an ancient example; the Cambodian Khmer Rouge with their atrocities are a shocking contemporary one.

Since no evidence to the contrary is presented, I am willing to give Captain Kirk the benefit of the doubt.

Personal Computing provided an extraordinary service to its readers when it published the Star Trek program in an earlier issue, I would have been greatly offended had some extremist political sensibility induced you to "censor" it to protest this or that perceived iniquity.

Other periodicals are better suited to address political questions of the day. *Personal Computing's* reason for existence is its competence to communicate matters of technical and avocational interest to computer hobbyists. In order to grow in circulation and professionalism, I think you would be well advised to keep a sharp focus on that objective.

So, let's let this be the last letter on "political" issues. But keep those program listings coming!

Thomas G. Holford
Alameda, California

While Kirk will surely be gratified to get the benefit of the doubt, it may prove difficult for anyone to have the last word on political matters, since people do write interesting letters (like this one) that deserve publication. A couple of points — Steve Pollini's Star Trek article was edited rather severely to fit limited space, and was slightly muddled in the process, politics aside. Then too, PERSONAL COMPUTING is designed for consumers who happen to be interested in computers, not specifically for hobbyists, though hobbyists are a subset of that larger group, and we hope to be useful to hobbyists. It's a complicated world. So far, we've been accused of sexism, intellectual snobbery, anti-intellectualism, male chauvinism, national chauvinism, racism, general foolishness, technical snobbery irreverence, reverence, ignorance, rightism, leftism, radicalism, complacency, and cheerfulness. The letters are not all entertaining enough to print, but it's nice to know that people are interested in improving our character.

Dear Nels,

The omission of identification of the modules in the "Towers of Hanoi" program flowcharts which accompany our article on "Loops" must have made them difficult for readers to use. (July/August issue).

On page 102, the Control Module starts with the first "Enter" block in column one and contains a printer's error: the connector from the "mode" decision block should be shown to connect with the connector marked (2) at the top of the next column, if Mode = 0.

The Calculations Module starts with the "Enter" block at the top of column three on page 102. Its "Do Move" submodule begins with the "Enter" block halfway down the fourth column on the same page and contains another printer's slip: the block below the connector (3) should read "Set the contents of the address shown by TEMP1 = zero (not phi, ϕ, as shown).

The "Get Top of Stack" submodule begins with the "Enter" at the top of column one on page 103. The "Enter" farther down the same column begins the "Alternate Move" submodule. In the "Alternate Move" submodule, at the comparison of TEMP3 and TEMP4, the leftward pointing arrow should be followed if TEMP3 *greater than* TEMP4 and the arrow pointing right shows the flow of control if TEMP3 *less than* TEMP4.

The "Output Board" module begins with the "Enter" at the top of column two on page 103 and its "Write Line" submodule begins with the "Enter" at the top of column three on the same page. In the "Write Line" submodule, the block after "PRINT1=Contents of address Shown by TEMP2" should read "Let PRINT2=8-PRINT1". The "Initialize Stacks" module begins with the "Enter" at the top of the fourth column on 103.

The "Output Spaces and *s" submodule appears on page 104.

Thanks for printing these identifications and corrections. I'm sure they'll make the flowcharts easier to use.

E.M. Hughes

Ooops!

Gentlemen:

If an article was ever tailor-made for one, then the one appearing in the July/Aug. edition on Microcomputers in the neighborhood drugstore was for me. ("Personal Computers in Your Neighborhood Drugstore," by Barry and Allen Yarkon).

About a year ago I got the brilliant idea that a μC should be able to do a lot of the tedious record-keeping most pharmacies must do . . . . . at a saving of pharmacists' time, at least 2 hours per day @ $10 per hour minimum would amount to $6,000/yr. at least.

A pharmacist in a rural area would have to trust a salesman, technician, and perhaps programmers to install and maintain a computer. Being 180 miles from a large city would mean down-time, frustrations, and so on.

So I took a correspondence course . . . (Heathkit) . . . starting with . . . "electricity is the flow of electrons in a conductor". . . and ending with the digital training finished last week on the programming of a microcomputer. I purchased an MMD-1 kit, have built it, have learned to machine program, and have all the peripherals on order to interface it with the components I *think* I will need in order to set up a program to operate in my own drugstore. Too, I think I will be able to hand it to one of the employee pharmacists, and say, "Here, use this to type the label, and all the entering on the patient's record system will be done for you." What delight to receive this month's issue to find that the pharmacists in N.Y.C. have already done this.

I enjoy your publication very much, even if I can't understand it all yet. What the Hell's a raster line?

Sincerely,

Jim Jackson
Princeton, B.C.,
Canada

Reader Jackson is one of several pharmacists who responded enthusiastically to the Yarkon article. There's both good and bad news for them. The bad news is that Part II of the series is still unfinished, because the authors haven't yet got their multi-user system operating the way they think it should. Since that system is the primary subject of the article, it seems worthwhile to wait a bit. The good news is that an S-100-based commercial system for pharmacies is now on the market, offering flexibility as well as specialized utility to the interested pharmacist. The system is produced by Kerr and Reynolds Corp., 4372 Woodman Avenue, Sherman Oaks, California 91423. Basically, the system uses a Cromemoco Z-2 computer

Letters

with an Icom dual-disk drive and a Soroc terminal, with an optional printer. The software package is the company's own. This system was altruistically pointed out by Harry Garland, friend and, incidentally, president of Cromemco.

Of course, if you're 180 miles from a major city, you may really want to be able to fix everything in your basement. By this time Jim Jackson may be a valuable advisor.

And a raster? The dictionary says it's the area in which an image is produced on a television screen, but some of us think of a raster as the array of lines drawn on the face of the screen by the flying spot of electrons striking it from inside the tube. You can display a raster that shows no picture. Indeed, you can produce a visible raster in other ways, but if you get involved in all that, it will distract you from pill-rolling.

Dear Sirs:

In your May/June issue, David Galef in "A Chess Piece" said, ". . . and incidentally, BASIC is not a good language for this type of programming. . ." — meaning, of course, chess.

Why isn't BASIC good for programming chess? What language does KIM-1 6502 use? What language does the Northwestern program use? What language does SCHACH MV5 use? What language does the Cardinal program use? Which language(s) is/are best? Why?

To your knowledge, is anyone indexing chess programs?

Jay H. Beckerman
Fort Lauderdale, Florida

With all the complex operations that go into making a chess program, a sophisticated enough language is needed to translate commands and data into a workable system. BASIC, while useful for a great number of areas, is simply not tightly-structured or fast enough; it is always executed indirectly after an interpretation process, and it can't store data in complex patterns.

As for your other questions: Northwestern's program, running on a CDC Cyber 176, uses assembly language, as does KIM-1 6502, but as for Cardinal and SCHACH MV5.6 — all I can say is that the latter was written by Helmut Richter at the University of Hamburg; you might contact him. I've never heard of Cardinal, however. In general, the best languages for chess programming are those that are most compact: FORTRAN and assembly are often used, sometimes ALGOL.

Last: while I know of no formal indexing system on chess programs, David Levy has done a good job of listing and describing a fair number of programs in his books **Chess and Computers** *and* **1975 U.S. Computer Championship.**

David Galef
Scarsdale, New York

Dear Sirs:

Paul Conover's articles on running computer stores (See LOOK OUT FOR LOP, Parts I and II, July/Aug, Sept/Oct) are both encouraging and frightening. I would never have thought of most of those questions he brought up, and I am glad to have that list before I take a chance on a store with my hard-earned money. Unfortunately, I can't figure out the answers to a lot of these questions. Are you going to print an article by Conover giving all the answers? Does he know the answers himself? If you are not planning to give us that article, where can I reach him?

By the way, I like your magazine, but I wish you would keep it so simple technically that even a grown-up can understand it. I have to ask my children to explain some of the articles, and it's embarrassing. Please don't print my name, because I don't want to alert my potential competitors.

Yours truly,

Name Withheld
Great Falls, Montana

Mr. Conover charges more money for answers than he does for questions, so PERSONAL COMPUTING will probably not be publishing his information soon. He can be reached by writing Box 7343, Oakland, California 94601.

Dear Editor:

I first heard of microcomputers about 6 months ago. Your magazine was the only one on the shelf that seemed readable at the computer store I first visited. I bought books and in whatever time I've had, I've studied microcomputers. I go to shops and I went to your West Coast show, which helped. But, gee whiz, am I ignorant! I pursue many activities, so I can't devote myself to microcomputers full time. Even if I did, I don't think I could keep everything straight! There are so many manufacturers of competing products that, despite your good article on system selection, I'm bewildered. And how much memory do I need? What determines best word length? Why is 8K of 12-bit words (ref: TLF ad, p. 129 of July/August issue) better than 8-bit bytes? Why a dual floppy? Isn't one enough? What can you DO with 32K of memory that you can't do with 16K and a storage?

Jay Stern
Los Angeles, CA

Letters like this are a great help, because of the specific questions asked — though the answers can't be supplied satisfactorily in a quick response. A trial shot — longer words are handy if you are dealing with big numbers. Saves processing time since you don't have to do double-precision (or more) arithmetic. (See Jef Raskin's BIG COMPUTER, LITTLE COMPUTER, March/April). 32K of memory lets you run programs like Gene Dial's CONFEREE in this issue, while 16K won't handle it in one fell swoop. No beginner has the judgment to determine how much computer is needed for the class applications he has in mind for his system. That's a curse that comes with being a beginner. The curse for the old-timer is that he can't figure out where to begin an explanation, and sweeping surveys aren't always helpful. Ask some more specific questions and we'll try to get some greybeard (probably 17 years old) to answer in a regular column.

Dear Sir:

I recently purchased two late model computer processor assemblies from a salvage store, and I would be interested in purchasing some peripherals to implement a microcomputer system if I can find out what I have.

Each unit consists of four circuit boards, and the housing is labeled "processor assembly part no. 30007." One board is labeled "processor board 1, 70001 Rev. 12." One is labeled "processor board 2,70010 F-01 and DS 1540-002AS-05 REV 09." One is labeled "Memory Board 70003 F-07."

There is no manufacturer or vendor's name on any of the units, but the memory board has a special symbol. Several boards have a rubber stamp indicating they were serviced by TRW, but I cannot get any info from them.

I would appreciate it if you could give me any information or tell me where I might find some information on these processors.

Yours Truly,

G.M. Durrence
Decatur, Georgia

Do these numbers stir any useful memories? Reader Durrence seems to have much in common with Ralph Chandler, the demon cameraman and collector of interesting junk. Ralph entered a conversation once with: "What are you looking for? If they sell it in a surplus store, I've got one." Only a slight exaggeration.

When you buy a microcomputer, is this your selection?

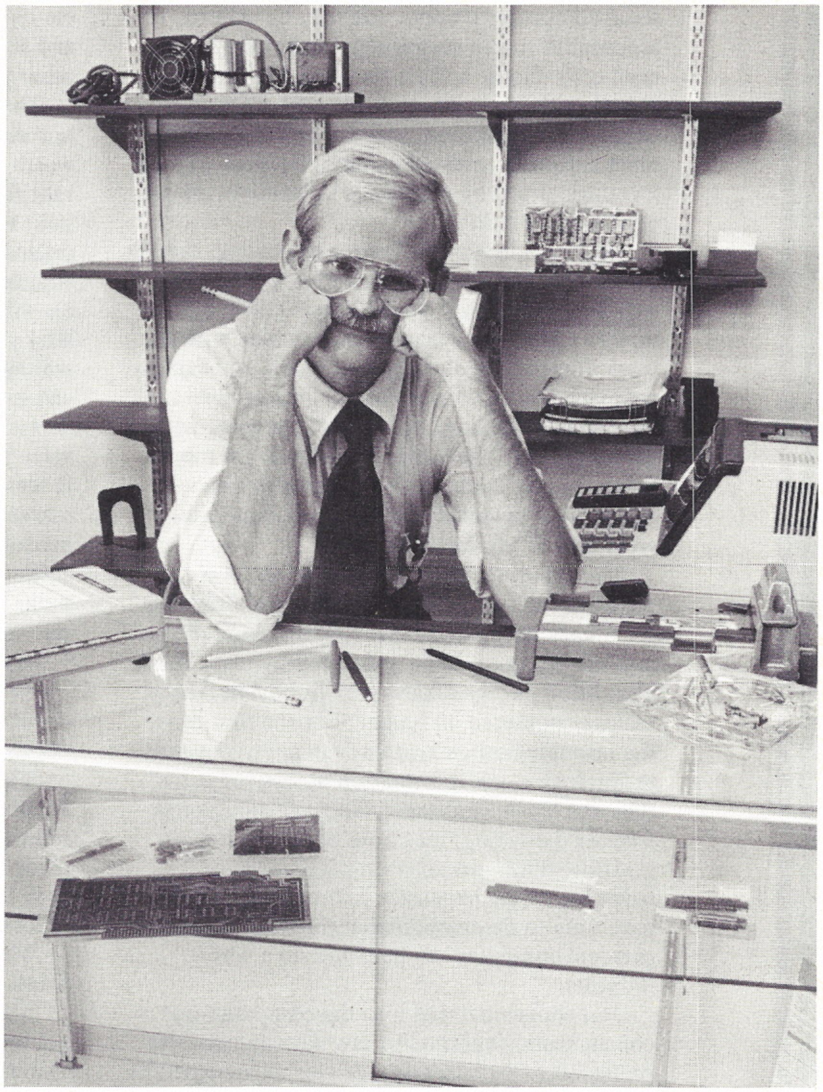
Your choice of what's on the shelf? Or, four week delivery?

At The Computer Mart, we have a full selection of hardware and peripherals. For delivery today. You can choose from all the major brands like Imsai, Polymorphic, Processor Technology, Cromenco, Apple and others. Take your pick of peripherals, terminals or monitors. Everything you need for a complete system. For personal use or for business.

We're the experienced microcomputer dealer. One of the first stores in the country. One of the largest around today. And, you know we'll still be around after you buy a microcomputer.

And, that's not all. We support what we sell with a fully staffed service department. We guide you in selecting the right combination of hardware and peripherals. And, we're there to help you with classes in software and programming. Backed by an extensive library of basic computer publications.

At The Computer Mart, we give you a choice. So, stop in or call today. And, take your pick.



THE COMPUTER MART

633 West Katella Avenue, Orange, California 92667, (714) 633-1222

Hours Monday–Friday 10:00–8:00
Saturday 10:00–5:30

BankAmericard and Mastercharge Accepted, Leasing Available.

At The Computer Mart, we do more than just sell computers.

For professional advice before choosing your system, call The Computer Doctor.

CIRCLE 6

With Colonel Colt's six gun, the uneasy average man was equal to the dangers of the frontier. The uneasy average man at today's frontiers of knowledge can hold his own with the personal computer.

Would you enjoy renown as the world's foremost authority on some subject, seeing your name tucked into the footnotes of papers in prestigious journals in many languages? With a personal computing system, you may be able to accomplish this in surprisingly short time. You need only choose a topic for expertise in which nobody else has yet been interested. With practically no competition, you can become the foremost authority, pressed by clubs to speak at their meetings, urged by publishers to let them release your work in print.

Most information is free for the taking, though it may cost you time, effort and postage to get written material into your hands. Setting out now to collect information and sticking with the work diligently for a couple of years, you can expect to be up to your eyeballs in material and to have an entertaining correspondence going with people all over the world. You'll have far more than you can handle unless, of course, you've taught your personal computing system to do a great deal of the work for you.

The beauty of the computer is that you can drop information into the system randomly and get it back *in order.* In the past, that kind of sorting and sifting could be done only by institutions, by fulltime professionals or by hobbyists whose zealotry bordered on lunacy. For the first time, the resource-limited amateur can apply powerful technology to his information processing activities and that's significant. While information is free for the taking, the chore of classifying, organizing, filing and retrieving the free stuff is overwhelmingly expensive in time. You don't have time to do *everything* in this world, but the personal computer can help you do a whole lot more.

Just shovel material into the computer as it comes, storing volumes of raw data on cassettes or discs for later attention. If you've thoughtfully labeled the input by category – geographical location, color, weight, age, style, smell, state of preservation, environment, state of health, whatever – you can persuade the computer to sift through the recorded material and print it out for you in orderly form or to run statistical evaluations. Keyword searches give you another handle on the information by way of classification and analysis makes it valuable in some way to other people.

The mere fact that you have assembled and processed a body of information is interesting, worth an article in the local paper or in a relevant technical journal. The first discussion of your work in public will precipitate more miscellaneous information input to you from strangers. These things snowball . . . soon strangers will be asking for orderly lists of information. Why you? Who else? Chances are that they'll be willing to pay copying costs for the data. You can set the computer to searching the whole works and printing out unique listings whose value you may not have suspected yourself. It seems fair to charge for your service if the market will bear it. Perhaps you'll become a consultant at an attractive fee if the demand is sufficient. Pipe dreams? Maybe, but your computer is a tool to help you build real situations out of these fantasies.

But aren't all the good subjects taken?

Well, is anybody offering computer listings of haunted houses with classified listings of eerie occurrences? Can the names and addresses of people who own these houses be purchased with a report on their attitude toward visits from researchers? Do you know what efforts have been made to record and analyze the strange phenomena? Do you suppose there's a market for this processed information?

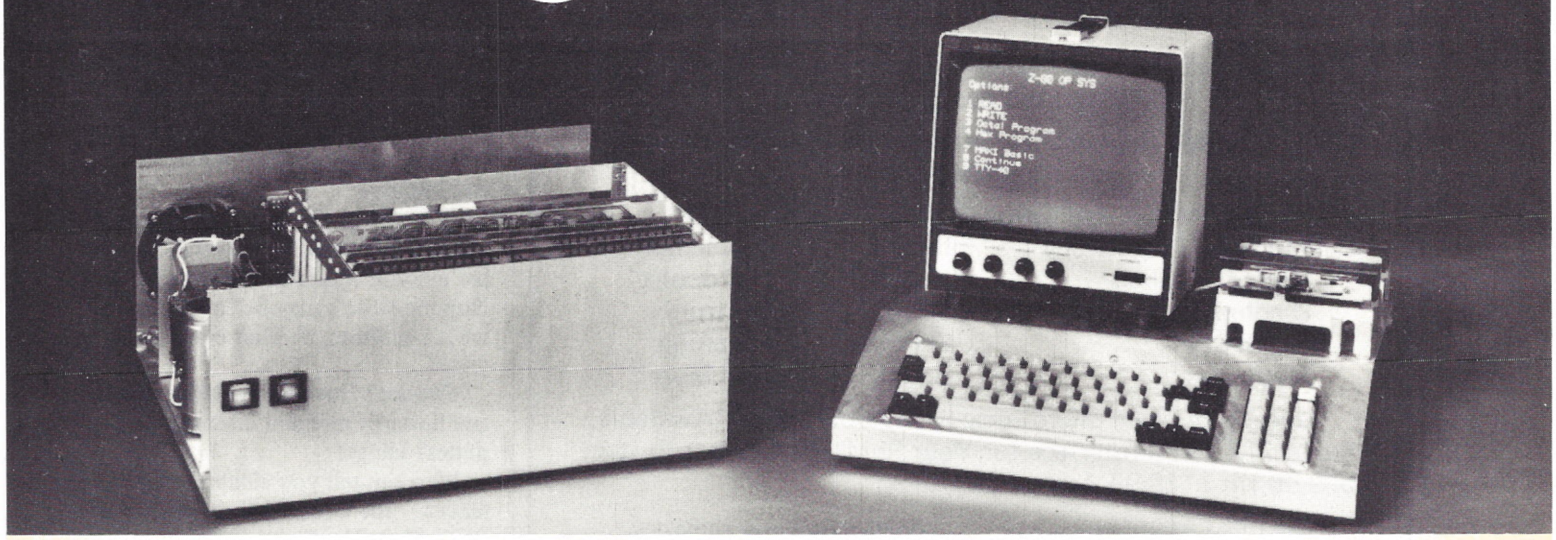
Who offers computer guidance to treasure ships, lost mines, buried jewels?

Who has a computer-accessible data base treating the great peaks of the world of interest to climbers – with lists of expeditions, accidents, changes in terrain, jurisdiction, climate? Can you schedule your climb with a central clearing house?

Can somebody quickly send you a complete

It is: THE EQUALIZER

Up your organization.



The Basic Box (left) and the Peripheral Plate.

With no-nonsense organizers from the Digital Group.

Not so long ago, the microcomputer domain belonged to a special group of creative, inventive folks — the inveterate hardware hackers who delighted in making a thing work and didn't really care all that much about how it looked.

The Digital Group was a part of it. Our original microprocessor systems were designed not to require any cabinets at all — they simply worked well.

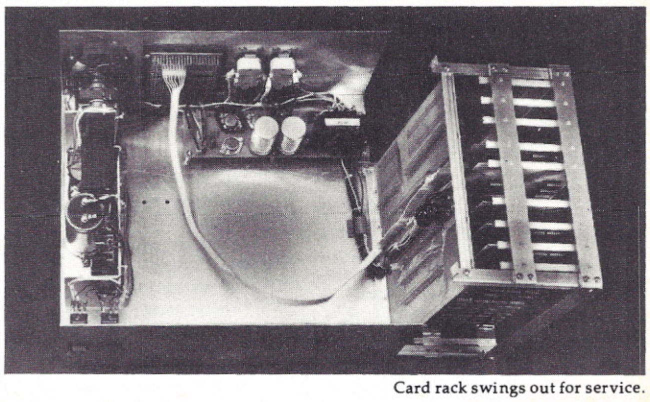
Of course, along the line we couldn't resist making a good thing look good too . . . and we added our complete line of custom, deluxe cabinets to cover up.

Well, we haven't forgotten those no-nonsense computer builders who just want a way to organize their systems. So the Digital Group has taken a step back to come up with a basic answer: The Organizers — the *Basic Box* and the *Peripheral Plate*.

Beautifully simple. No paint. No anodizing. No frills. Just exactly what you need.

The Basic Box houses your CPU, power supplies, fan, switches and I/O connectors in one tight little 16" by 17" package. It's available completely naked — a metal box with a card rack so you can add to it from your own parts supply; or we'll spiff it up for you with optional equipment.

The Peripheral Plate is a piece of bent metal with room for your keyboard, video monitor, two Phi-decks or an audio cassette recorder. All at your fingertips. For organization.



Card rack swings out for service.

Naturally, our basics have down-to-earth prices, too. The Peripheral Plate is a mere \$19.50 . . . the basic Basic Box goes for \$45 (a little more depending on options).

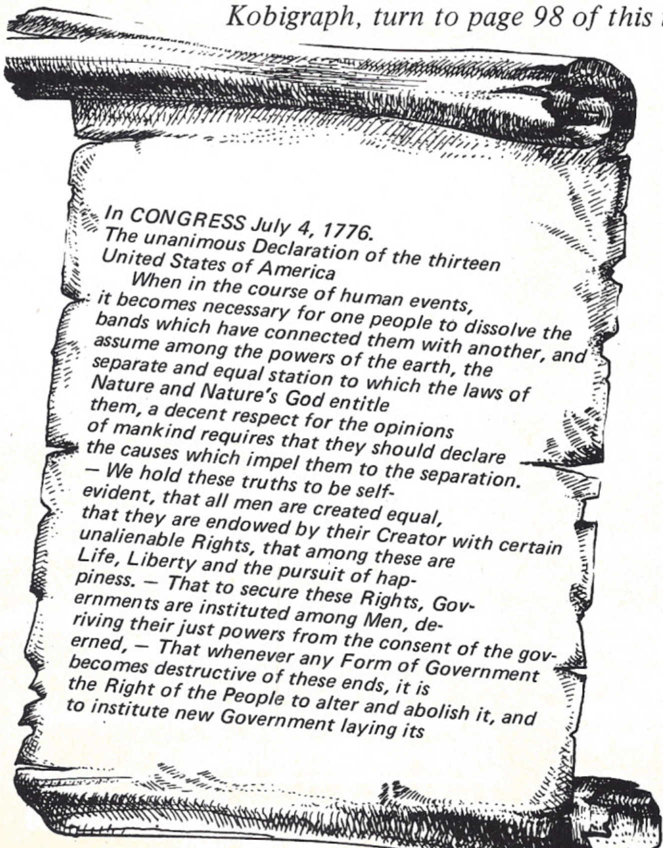
Want to up your organization? It's simple. Just call or write the Digital Group for details.

the digital group

P.O. Box 6528 • Denver, Colorado 80206
(303) 777-7133

CIRCLE 7

You probably read this document in third grade; some of us even had to memorize it. To find out why it's here, and to discover the Kobigraph, turn to page 98 of this issue.



computer printout treating casting compounds for taking facial molds and listing current suppliers for mask-making materials so you can produce a Halloween extravaganza in a few weeks?

Whose computer can tell you all about the world's breweries, the varieties of beer in manufacture, the distribution channels, the availability of brewing materials, the names of the brewmasters, sources of mead, kvass and kumiss?

How about classic cars, the collector's items? Can somebody's computer list tell you where all the existing Hispano-suiza's may be found, in what condition, at what conceivable price?

Cheeses? How about coffee, tea and and herbs of rare and interesting varieties? Wines?

Who can tell you all about walls and fences – the Great Wall of China, Hadrian's Wall, The Berlin Wall? What parts of the great walls are still standing? Where? Of what are they made? How many walled cities still exist? Are the walls effective? Moats?

And string. Can you buy string made of human hair? Where? At what price? How strong is it, what color, how long does it last? Are there dealers of specialty strings? Are strings all twisted, some braided, any woven? Who knows all about string, rope twine, thread, cable, chain?

Can you check with anybody for a quick comparison of the date 1176 A.D. with the Mayan calendar? Who can help you correlate historical dates in many calendar systems that have undergone sharp revision over the centuries?

Where are all the zoos? What animals are where? How are they doing? New cubs? Rare species?

Containers – barrels, kegs, firkins, tubs? Of wood, bamboo, steel, copper, stone, ceramic? Who, where, why?

Trade and travel routes and vehicles. Museums and exhibits. Airlines, airplanes, and routes of times gone by. Bicylcles, unicycles, trikes, pedicabs. Boots. Paints, varnishes, lacquer, protective oils. Cosmetics. Sidearms, muskets, swords, dirks. Streetcars, cablecars, railroad engines. Adhesives. Magicians and illusions. Odd musical instruments and music for them. (Where are all the glass harps, eh?)

Weathervanes. Lightning rods. Old books, famous jewels, famous paintings, oriental carpets, bottles, jugs.

When New York decided to collect tax on old moulds preserved by a two-hundred-year-old iron foundry, the company decided to destroy the irreplaceable, but uneconomical, collection. Who has iron moulds of historic value? Can they be found quickly for special needs?

Old cameras? Packaging materials? Who will move an astronomical telescope up a mountain for you or transport a herd of cobras to Congress?

Lucy's Little Known Facts are lying around all over the countryside, waiting to be picked up and processed. You don't need permission from existing authorities to muscle in on their fields. You don't need a license from the city hall or a state university to put your brain and your computer to work. And you begin to learn the oddest things right away.

"During a two week period in July, 1963, 75% of the fish sold at the Koki fish market at Port Moresby, New Guinea, were tilapia harvested from the inland swamps and lakes, because storms at sea prevented the boats from going out for the usual fish. The tilapia were seeded in the inland waters during an experiment in the fifties." That experiment protected life and health. Where else were the fish released? Where else did they flourish? How are they doing in Port Moresby these years later? The odd information about Koki fish market came in a personal letter from the chief vulcanologist at Rabaul while this writer was becoming, briefly, the world's foremost authority on the distribution of active volcanoes for a space navigation project in which natural infrared beacons were being sought to guide what became Skylab. The correspondence and the information were both extremely entertaining . . . but personal computers weren't available then and laziness prevented systematic collection and processing of the miscellaneous material. Ah well.

If you begin now, you can become the world's foremost authority on foremost authorities . . . telling other people where to find the experts they need. Start with yourself. **NBW III**

How to get more bytes for your buck.

First, come to Micropolis. Where you get a MetaFloppy™ instead of an ordinary 5¼″ floppy disk system.

Then, forget all things average.

Because the Micropolis MetaFloppy delivers over four times the 70K (or so) bytes of storage you'd expect. A whopping 315K bytes per disk to be exact. All formatted — not raw. And all on a single disk side.

But that's not all. Because Micropolis delivers everything else you need, too. Power Supply. Interface cable. Extended BASIC software. Plus an S-100 controller for your Altair 8800, IMSAI 8080, COMPAL 80, or the like.

There's even a dual drive model for maximum convenience. And savings.

The Micropolis secret: We build *every* component we sell. In fact, we're the only totally integrated 5¼″ floppy disk system builder around. And where there's no middleman, there's no middleman to pay.

So, before you swallow someone else's price/performance story, find out how much your buck really buys and how much faster it buys it — at Micropolis.

For a free brochure and price sheet, write: Micropolis Corporation, 7959 Deering Ave., Canoga Park, California 91304 or phone (213) 703-1121.

MICROPOLIS™

Random Access

Is There A Doctor in the House?

When a Spanish sailor on leave in Seattle suffered severe abdominal pains, he had two big problems: the pains and his inability to tell anyone, in English, about them. But thanks to a friend and a computer-based information system at the King County Medical Society, a Spanish-speaking Seattle physician was located. Within a few minutes, the doctor was available to help treat a man who otherwise might have been difficult to aid, because of the language barrier.

This call is reportedly typical of more than 125 referral requests that are processed daily by an IBM System/32 operated by the 2200 member medical society. KCMS has not only found a way to ease its growing pains, but has found a way to use its computer to do people some direct good. The online system provides rapid access to physicians who may speak one or more languages of a list of 70 from Afrikaans to Welsh.

Among other direct benefits:

— Preparation of the annual directory, which formerly took six weeks, is now handled overnight.

— Response to requests for names and addresses of physicians with particular specialties or services, often impossible to answer with manual records, now takes less than five seconds.

— Cross-indexed lists of members within a given zip code area can be compiled in minutes.

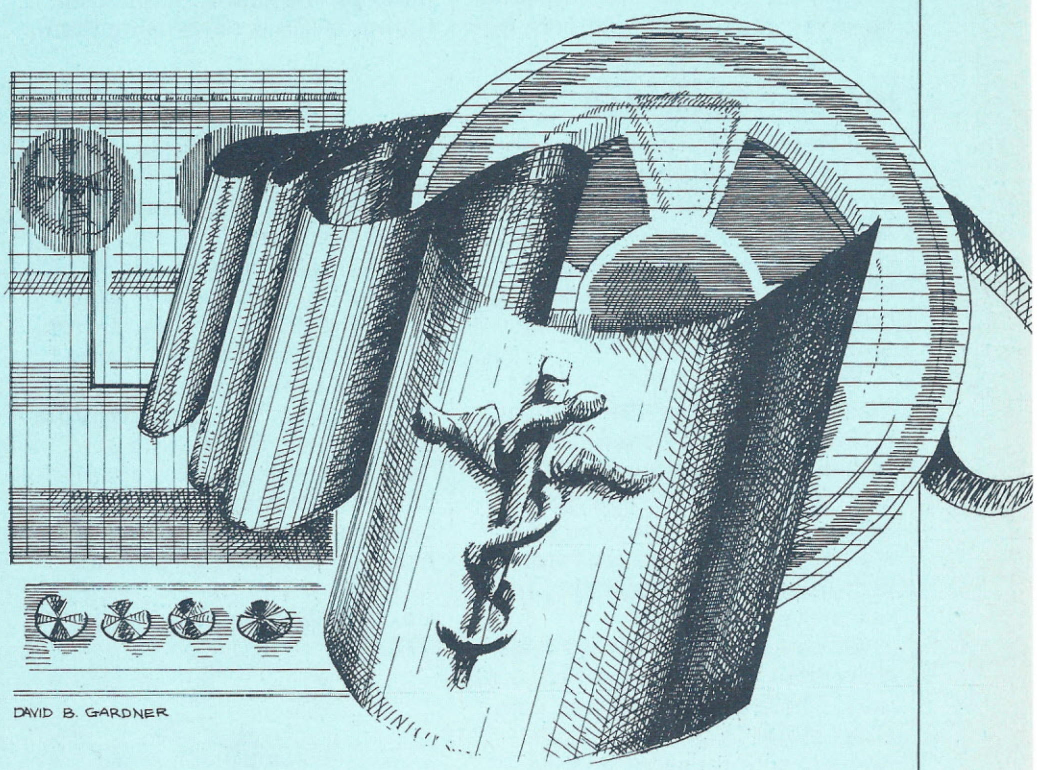
— Statistical summaries can be based on the entire membership, instead of on a smaller sample population.

The system is based on a pattern developed by the American Medical Association called the American Medical Computer ASsistance Program (AMCAP). The scaled-down version for King County was unique when it began operation in September of 1976, but interest from other groups has been great and similar systems will be coming into operation fairly regularly. KCMS estimates that any society with 400 or more members could afford the IBM system with its 32K of memory, 9.3 million character disk file, 100 line-per-minute printer, and video display with a keyboard.

And what about smaller groups with similar needs, but no budget, limited personnel, and no computer expertise? Though the field is immensely complicated by requirements for confidentiality, it seems possible that computer amateurs who are interested in doing people some direct good might find a way to do it, enjoying the activity almost as much as they enjoy Star Trek. This brings to mind the old hymn:

Let the lower lights be burning.
Send a gleam across the wave.
Some poor struggling seaman,
You may rescue, you may save.

Nice application for our technology, what?



Big Help

Douglass Boseman figures that he has more than his fair share of commercial obstacles to overcome. His company, ComputerCo, Inc., manufactures a small business system of which he is extraordinarily proud, an 8080-based computer with 32K, twin floppies, and a printer, all packaged in a nice desk, complete with proprietary software at a price Boseman considers modest. He's more than a little huffy, though, that potential business and government customers treat him like a country bumpkin, because his business is located in Charleston Heights, South Carolina, not in Silicon Valley, Boston, or some other section noted for its high technology. (And Boseman **sounds** as if he's from South Carolina.) That's all right; he's making headway against regional bias, but he's not sure his Yellow Pages advertising is doing him more good than harm. Ma Bell's admakers thoughtfully combined two ads he sent them from the same address (one for his store, World of Computers, the other for ComputerCo) into the hodgepodge shown here, and invented a brand

new product he didn't know he carried. Anyone interested in sloppy discs (double density at that) will be glad to know that ComputerCo is advertising them.

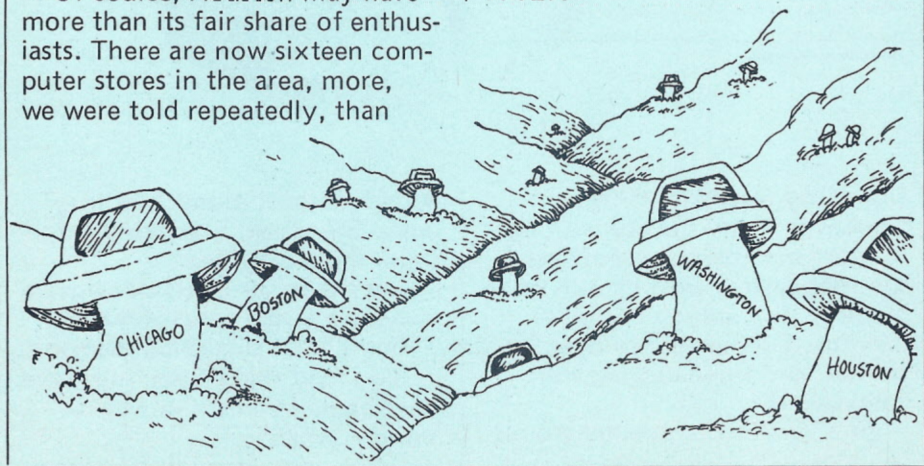
Houston Did it Well

The Houston Personal Computing Faire was organized in haste, promoted in a panic, publicized too late — and it worked like a charm, because the people behind it were interested in serving both the exhibitors and the attendees well.

With shows popping up like mushrooms all over the country, it's difficult to pay adequate attention to any but the big ones, but Houston was a treat, busy and exciting (but not jammed), inexpensively housed (but not tacky), brave and interesting (but not pretentious).

Of course, Houston may have more than its fair share of enthusiasts. There are now sixteen computer stores in the area, more, we were told repeatedly, than there are in Los Angeles. (Cough, cough.)

They'll do it again next year and if the same folks are running things, it will be even bigger and better. The management gave warm thanks to Jim Warren for passing on what he had learned from his Computer Faire in San Francisco . . . and apparently for passing along his spelling of "fair." If other novices are planning to take the plunge into show business, they might want to tap Houston for some of their information. Try Joe Rogers, P.O. Box 22486, Houston, Texas 77027.



On The Toe of The Learning Curve

A few manufacturers of wonderful new easy-to-use, BASIC-in-ROM computers have kidded themselves into believing that anybody who can operate a record player can, with two minutes of demonstration, operate a computer system, programming in BASIC. "We don't even need to train the salesmen," they say, "the machine sells itself."

Well, not quite. Mark James dropped into a Radio Shack store in Los Angeles to buy one.

"Understand you're going to be selling computers," says Mark.

"Yes, and people seem to be really interested," says clerk.

"Do you have any in?"

"Not yet, and I haven't even seen one myself. This was just announced, but they've told us about it."

"What will this computer do for me," says Mark.

"Well, it will balance your checkbook."

"Good, I need help with that."

". . . and it will keep recipe files for you. . . and it will play all kinds of interesting games. I guess it will do more than that, too," says clerk.

"All that for only six hundred dollars," says Mark.

"Plus tax."

"That's a bargain, even with the tax. What languages will this computer support?"

"Four of them," says the clerk

"Four? Wow. What are they?

"English, French, Spanish, and German," says clerk, happy to have found a sales point that impresses his prospect. Then he hesitates, and a shadow crosses his brow. "I take that back," he says. "I'm not entirely sure about that last one. The first three are set, but I think they're still working on German, so don't depend on it."

Mark took his advice, and is not depending on the TRS-80 to chat with him in German. While it's true that the machine might have sold itself to this well-informed prospect, it seems that a bit of training for the clerks wouldn't actually hurt.

. . . And In From The Side

While PDP-8's and 12-bit words are still fresh in mind (see item above) give a thought to the MINI-12 that has been brought to the market in the last few months by TLF, of Littleton, Colorado. A number of readers have asked about this system, chiefly wondering what magic there is in 12-bit words.

The MINI-12 is an interesting effort to take advantage of history. Newcomers to the computer field know that billions of dollars and untold man-years have been spent on computers in the last three decades, and it's a shock for them to discover that it's almost impossible to use what has been created in the past. Both hardware and software move along so swiftly that almost every machine is unique, and every program is a temporary fix for some special task. Well, not quite, but it's extremely frustrating to re-invent everything from scratch every time.

One outstanding exception to this general problem is the collection of software that has accumulated around DEC's minicomputer, the PDP-8E, probably the most popular small computer in history.

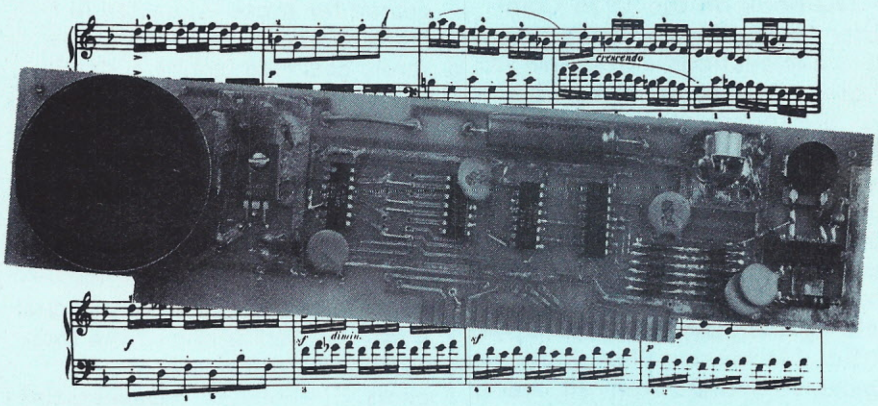
When Frank Laczko decided to produce a personal computing system, he based the unit on a microprocessor chip that simulates the PDP-8 (surely the same chip used in the DECstation, above) so that the computer will run most of the existing library of PDP-8 programs. Most? Yeah, well. . . most. And a tremendous storehouse of stuff is available. DEC's DECUS library provides a two-inch-thick book of program listings, that is, lists of **names** of programs, not the programs themselves. For two or three dollars each, the eager machine user can obtain paper tapes of the programs. It is possible to make some use of past work, not easy, but possible.

Even apart from tapping the reservoir of history, the MINI-12 is an interesting machine, especially with its MINI STORE digital cassette system, which is a classy, fast mass-storage system organized along DECtape lines.

And the 12-bit words? No magic, just a matter of going along with history. When people began to design minicomputer systems back in the early sixties, they were not constrained by the limitations of large-scale integration in microelectronics. Since they were using discrete components to build central processing units anyway, they could comfortably specify any word length that seemed good to them. Hence, there have been four, eight, twelve, sixteen, twenty, twenty-four-bit systems, with a few odd systems thrown in. Clearly, designers do not always choose powers of two for word-length. Even that magic does not apply to the MINI-12. The system is an intensely practical, old-fashioned workhorse that takes advantage of the past while offering lots of muscle for new applications.

Calling The Tune

It seems that everybody and his brother is producing plug-in circuitry that turns a computer into a music synthesizer of greater or lesser sophistication. In the couple of years since personal computing burst into full bloom, the hardware, software, and **sound** of computer music have all improved dramatically. The time seems less distant when "music by the numbers" (see Future Computing in the Jul/Aug issue) will be practical on a commercial scale.



Consider but one example of music boards (this chosen from many chiefly because of the nice picture provided by the manufacturer, Newtech Computer Systems, Inc., 131 Joralemon Street, Brooklyn, New York 11201). At $59.95, assembled, this board generates melodies, rhythms, sound effects, Morse Code, touch-tone synthesis "and much more." The board comes with a user's manual, a BASIC language program for writing musical scores and an 8080 Assembly Language routine for playing them. The board is S-100 bus compatible.

For about two hundred dollars, ALF Products, Inc., of Littleton Colorado (128 S. Taft St. zip 80228) will supply a single-board pitch generator that produces one to four tones simultaneously; two such boards can be used to generate eight tones in stereo. Each of the tones is controlled separately over a range of eight octaves. Additional boards in the series will allow control of other musical parameters. ALF offers product information free, a demonstration record for a dollar.

With these and other products in the field, it has become increasingly easy to persuade the computer you already have to simulate the mighty sounds of a big electronic organ. The question is whether you want to or not.

words of worth

1975 U.S. COMPUTER CHESS CHAMPIONSHIP, by David Levy, 86 pp. CHESS AND COMPUTERS, also by David Levy, 145 pp. Computer Science Press

Computers have been playing chess since the 1950's and by now some of them are developing into pretty fair players. David Levy himself recently played a computer at Carnegie-Mellon University as part of his bet that he will still be able to beat any computer at chess by August 1978. Levy did win the game, though it took him forty-two moves. There is, without doubt, a steady trend of better and stronger-playing chess programs and computers. As Levy's two books on computer chess more than adequately show, however, good chess games from a computer are still an anomaly and the science of computer chess still has far to go.

The book on the 1975 Computer Chess Championship contains explanations, notes and an afterword by David Levy who was the tournament director for the event; the volume is essentially a compilation of the games as they were played, round by round, during the contest. The 1975 contest was the sixth in a series of tournaments held by the Association of Computing Machinery. Played among twelve computers from all over the country, including one from the University of Toronto, the tournament had a predictable ending: Northwestern's program, the winner in '71, '72 and '73, now updated to CHESS 4.4, made a clean sweep — no great surprise, since it examines over 40,000 positions a move.

Interesting to browse through and certainly one of a kind this book presents a problem: it contains little for the straight computer enthusiast since it is just a collection of chess games. Much of what Levy does say about computer chess theory appeared in an article he wrote for **Chess Life and Review** in May 1976. Analysis given for the games is adequate, but the games are of a low enough quality so as not to interest the avid chess player. A person in the forefront of the computer chess field might find the book worth studying, but the book is more of a novelty than anything else. Those who are interested in the computing aspect of chess should read instead Levy's **Chess and Computers.**

Chess and Computers encompasses a much broader interest than the book on the 1975 tournament. Throughout the course of the book, Levy traces the history of computer chess, from the famous trick Automaton in 1770 to the latest developments in the field. The book covers all aspects of the subject, from ideas and concepts for programs to working systems and devices used by the professionals in the field. There are also the usual sample games from past computer matches. The book, geared for those interested in learning about computer chess, rarely gets into technical details.

Levy's book on the Computer Chess Championship is, unfortunately, a little too single-purposed, and game collections are common. His **Chess and Computers,** however, offers a good blend of chess and computing — Levy is, after all, an International Master as well as one of the foremost authorities on computer chess —David Galef

HOME COMPUTERS: 2^{10} QUESTIONS AND ANSWERS
by Rich Didday
Volume I: HARDWARE $7.95 in paperback
Volume 2: SOFTWARE $6.95 in paperback
dilithium Press
P.O. Box 92
Forest Grove, Oregon 97116

These two books are representative of the better class of literature for newcomers that is reaching the market these days. An interested reader can work his way through a huge amount of useful material in these books without being snowed by insider language, and without being patronized by the author. There are some inside jokes (references to people and schools of thought that are especially significant only to insiders — why jump on Ted Nelson, for example?) but they don't get in the way.

This is good old-fashioned teaching by the Socratic method in which a naive would-be computer user grills a knowledgeable computer user with 2048 separate questions about hardware and software, expecting, and getting, lucid answers in straightforward language. "You mean," says the inquisitor," that a company would sell me software that doesn't work?" The answer is not a simple "Yes," or even a hearty laugh, but a careful explanation of difficulties involved in debugging operations for all contingencies.

The questions are not just randomly asked, but are laid out in a sensible and comfortable progression that leads through almost all of the basic stuff a newcomer needs. However, the reader has nearly random access to the serial stream of Q & A. The material is arranged in sections by general subject, and of course it's easy to get a sense of the material in a particular section by scanning the questions.

NBWIII

worth of words

YOUR HOME COMPUTER, by James White, DYMAX, 1010 Doyle, Menlo Park, CA, $6.00.

Your Home Computer is written for the beginner and the pre-hobbyist with no prior knowledge or experience in electronics or computing.

In easy-to-understand language the 204-page book takes the novice on a painless journey through the world of microcomputer technology and terminology — from "What are Computers — Simply" to choosing your own microcomputer system.

Obviously, White couldn't cover everything about microcomputing in a single book. But he does an excellent job of presenting some of the fundamentals in an interesting way. **Your Home Computer** is not only informative but fun to read.

The chapters are short and carefully organized into brief subsections. This enables readers to flip quickly to only those topics of interest or to find a specific explanation without having to hunt through the entire book. Terms and concepts are presented in a clear, straightforward manner without too many details or related ideas. Explanations are further enhanced by nearly 100 illustrations.

The first of four sections in the book gives the reader a general idea of how computers, particularly microcomputers, work. It includes chapters on computers as electronic brains, computer "thought" processes, communication and data inside a computer. Common computer terms are introduced — microprocessor, memory, I/O, bytes, etc. and some simple concepts, such as interrupts, how data travels through the computer on a bus and data coding.

For those interested in additional reading, White includes a separate chapter describing five sources. Throughout the entire book he systematically refers to other books and even users who can provide helpful information on various aspects of microcomputing. In the appendices he lists the names and addresses of personal computing periodicals, manufacturers, computer stores and a number of computer clubs located throughout the U.S. and Canada.

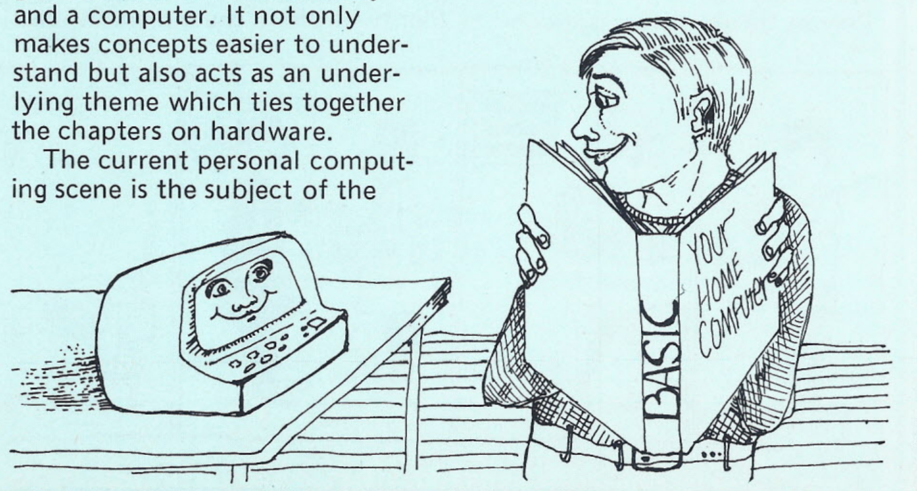
The second section of the book covers microcomputing fundamentals, such as selecting a microprocessor, fixed and removable memory, key input, video display terminals, other output, peripherals and system components. In the chapters on memory, White compares fixed and removable human memory to the same type of computer memory before going on to an explanation of ROM, PROM, floppy discs, etc. He consistently uses this approach of making analogies between the human body and a computer. It not only makes concepts easier to understand but also acts as an underlying theme which ties together the chapters on hardware.

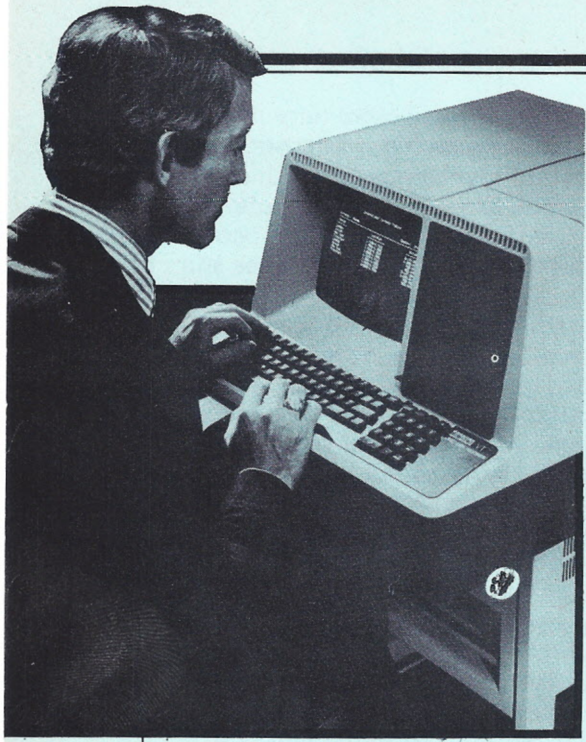
The current personal computing scene is the subject of the third section. Topics here include "Deciding on Your Microcomputing Involvement," "Builders and Sellers of Microcomputers," "Computer Stores," "Microcomputer Kits," "Panel Switches and Operating Systems" and "Programming — A Glimpse." The chapters on "Used Computing Equipment," "Mail Order Computer Vendors" and "System Selection by Weighted Factors" are particularly useful because they outline specific advantages and disadvantages of certain buying procedures. In "System Selection" White suggests a number of possible evaluation factors for beginners to consider before purchasing their computer systems.

White also devotes a chapter ("Computer Training Kits") to a brief discussion of the most popular microcomputer kits and programmable calculators on the market today.

The final section touches on some applications — fine arts, electronic hobbies, games, record keeping, etc. There's also a short chapter on needed hardware and software inventions.

The last chapter offers the novice some words of encouragement in regards to making use of the fundamental knowledge provided in the previous 38 chapters and some advice about how to get started in microcomputing. As White says, the fork in the road is not a 4-way intersection but a thousand-way intersection. Although you may be confused, the only solution is to make a choice and get going!





Down From The Top

While exciting new small systems are coming up into the personal computing market from below, a few interesting systems are coming **down** into the market from the big computer companies (E.g., Data General's NOVA, IBM's 5100). Digital Equipment Corporation is making no effort to sell into the personal computing market except via Heathkit with the LSI-11, but the company does sell a few products that look very attractive to the amateur. Consider the system pictured.

Although you might use it as a terminal for hookup with a larger remote computer, enough computing power is available locally in this new DECstation unit so that you don't need a big machine.

The unit is equipped with a handsome big keyboard, a video display, and a dual floppy disk. Inside, a single-chip version of the PDP-8 processor is at work with 16K words of memory. Note that the PDP-8 uses 12-bit words instead of the single bytes to which personal computerists are accustomed, so that 16K represents half again as many bits as usual. With a powerful operating system and both FORTRAN IV and BASIC programming languages, DECstation sells for $7,995. That's a long way from $599.95, but that's also quite a system.

Contact with the Outside World

Unless stern action is taken to assure contact with the outside world, computers keep their thoughts to themselves. Only recently has real emphasis been put on tying personal computers to real, working stuff. Among others Oliver Audio Engineering (7330 Laurel Canyon Blvd., North Hollywood, California 91605) is now offering new equipment for the purpose.

Their Computer Modules are complete, self-contained computers in little boxes, ready to be dedicated to control tasks, either independently or under the general guidance of a central system (your Altair? Digital Group System? Poly 88? whatever) that coordinates a number of modules. There are applications of interest in environmental control, security systems, games, telephone dialing, audiovisual systems, automotive accessories, robots . . .

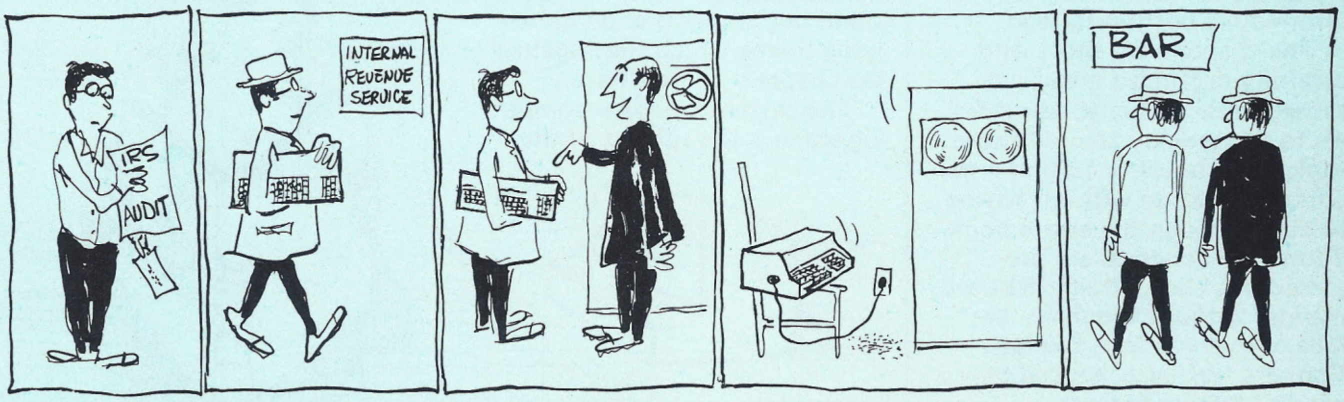
Oliver entered the personal computing market a couple of years ago with a very clever device that allows the user to read data into his computer from punched paper tape by dragging the tape over an optical head by hand. No motors, gears, noise or fuss. Cheap and simple. The company has expanded its line in in personal computing since then with surprisingly attractive little technical packages like their newest tape reader. Write them for further information on the new Computer Modules.

Running the Other Way

Just as a counterpoint to all the electronics activity, Creative Computing Magazine has developed a very entertaining, old-fashioned board game called COMPUTER RAGE. The game contains integrated circuits, flashing lights, color video displays, plus a set of cards, playing pieces and a game board. Amazing.

Players throw dice — not conventional dice, but binary dice whose sides are marked with one's and zero's. Each roll of three dice provides a binary value between 0 and 7.

Similarly, the symbols and procedures of the game are computer-related, with talk of input, interrupts, output queues, and check points. A computer game in fact. Plenty of life in the old traditions.

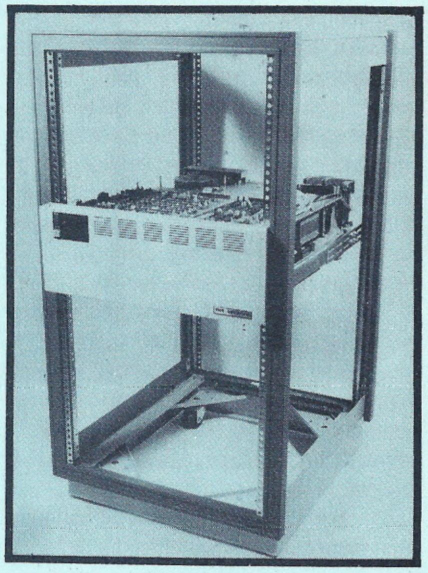


Babel Revisited

Computer languages like BASIC quickly develop many different dialects, acquiring the ability to speak commandingly to many different types of computers. The computers, unluckily, do not develop an ear for dialects, and obstinately refuse to operate if the user does not speak exactly the right dialect of BASIC. Consequently, a great deal of hard work is wasted or duplicated, because the owner of an Apple, for example, cannot run programs written for the Altair without modifying them. More, even when a knowledgeable programmer is writing material that should be useful to everyone, it's not possible to test and debug the work unless all varieties of computer are available physically for the purpose. (The professionals are no better off. Really big systems often acquire such profound individual idiosyncracies, that it's not possible to run a program written for one machine on another machine of the same model.)

The problem is being attacked in different ways. For example, a computer can be trained to act as if it were some other machine — that's what simulation is about — so that a machine that hasn't actually been constructed can be "tried out." Yes, it's possible to persuade a computer to emulate some other computer, not necessarily operating as fast, but performing all of the same functions by the same logic. M&E Associates of Cupertino, California is producing a system that will, they say, "emulate any processor," allowing a programmer to write and test software for any microprocessor at all. Given some encouragement, Michael Maples of M&E explains that their approach is novel, dealing wholly with function, rather than with the structure of a particular microprocessor. So if your purpose is to generate a great deal of programming for universal application, this system may be economical at about twelve thousand dollars. It's rather special.

Ohio Scientific Instruments is going another way with a very persuasive argument that it doesn't really cost much more to put three microprocessors in one computer for alternate use than it costs to put in just one unit. OSI's Challenger III is equipped with three microprocessors that will run virtually all software published for the 6800, 6502,



8080, and Z-80. For schools and for businesses using commercially packaged software, this flexibility can be extremely useful. If the industry isn't standardized, then this is a fairly sensible approach to getting one of everything. Challenger III comes standard with a dual floppy disk system, and is compatible with OSI's remarkable new 74 **mega**byte hard disk memory system shown here. (That's a lot of quick-access memory for $6000.)

Some of these microcomputers are growing up into systems with very impressive capability. While the developing ability to speak in many tongues isn't cheap, it is available on a practical basis. M&E and OSI will be glad to tell you all about it.

Making It Work

BASIC-E is a powerful, no-frill language (according to its enthusiasts) written by Gordon Eubanks. It is used on the CP/M disk operating system now fairly common. Since BASIC-E is in the public domain, owing to the circumstances under which Eubank worked, anybody is welcome to make free with BASIC-E.

The other side of that coin is that nobody has a commercial stake in applying discipline to the language, cleaning it up, and explaining its workings with care. Several versions of BASIC-E have been floating around in various stages of refinement, largely undocumented.

Now John K. Jacobs has published a thick book called USER's GUIDE FOR BASIC-E that pulls all the pieces together, describes the language and its uses, and supports the explanation with lists, appendices, glossaries, and references. If you're struggling with BASIC-E, and hoping that somebody else in the world is using the same conventions you are, this may be just what you need.

One reason the volume is an inch thick is that it's made up of double-spaced typed pages, Xeroxed on one side only, and bound in a standard office cover. Not the height of elegance in publishing, but practical. For information, write JEM Company, Ste 301, 2555 Leavenworth St., San Francisco, California 94133.

Among the Top 40

Radio listeners tuned in to their local disc jockeys at prime commuting time have been startled in recent months to hear spot commercials advertising computers. In particular Wang Laboratories, Inc. has been running a very entertaining spot promoting an inventory control system "for as little as $271 a month." For the first time in our experience, the mass media are being used to show the average consumer how a computer can help to solve specific problems with which he can identify.

Wang is trying directly to sell computers . . . and reports are that the effort is quite successful, thank you.

Innovation

Radio Shack surely didn't have this in mind, and Lear-Siegler will surely hate the idea, but a friend of Steve Pollinni (a sometime writer for PERSONAL COMPUTING) has figured out a fine application for the new Radio Shack computer system at $600. He plans to use it as an "intelligent terminal."

Ordinarily, intelligent computer terminals are used in large corporate systems when many users must have access to the big computer. One approach is to equip each user with a straightforward terminal, such as a Teletype machine that simply taps into the computer on some kind of timesharing basis. The other approach, since the terminal costs a pretty penny anyway, and some extra logic doesn't cost much more, is to build some processing capability into the terminal itself, so that small tasks may be accomplished with the terminal alone, not trying up the big computer. Neat. Inexpensive.

Now, Pollini's friend has a very nice little MITS 680 computer, equipped with a lot of memory, supported by a good deal of software PF has written himself, using a borrowed printer/typewriter — which has now been taken back. He searched around for another terminal at modest cost, and decided that he can adapt the TRS-80 computer, which comes complete with video control

"But, isn't that using a sledge hammer to kill a fly?"

No, not at the price.

"Besides," says Steve," there are all sorts of interesting things to do with this."

Like what?

Well, he hadn't really thought it through, but he pointed out that in a process control application, the TRS-80 might be used for all of the overhead work, collecting scads of data, putting out control signals, and storing information in memory, while the 680 does the real data processing. Similarly, one system may be set to chugging away at some time-consuming calculations while the operator uses the second computer on other tasks that are part of the overall job. When the first computer comes up with useful data, it can feed it automatically to the other system for attention from the operator.

Complex? Yes, in some ways, and the interfacing hasn't been worked out. It's tougher in this case, because the TRS-80 is a Z-80 system that would work most comfortably with another Z-80, or maybe an 8080 system, while the 680 uses the 6800.

But at the price. . .

Keeping up

As Don Robbins comments in his report on NCC in this issue, the current fad in computing is Distributed Data Processing. While this doesn't yet mean much to the computing amateur, the future may bring some interest in the area. The basic scheme involves trying a number of different computers together in a single system so that any one user has access to the full computing capacity (and memory capacity) of the whole system. If, for example, you want to run a big program with a lot of data that either exceeds the capability of your own computer, or would take impractically long to run, you may be able to use the excess capacity of some other computer in the system that isn't filled at the moment. In fact, your task may be run partly in various different computers scattered all over the countryside.

The amateur can imagine making use of the microprocessor that controls his heating system, the microprocessor in a high-fi system, and the microprocessor in the washing machine all to do computing tasks in connection with the home computer. It's by no means clear that the problem of handling communication among these devices is less expensive than expanded capacity in the personal computer itself,

If you'd like to know more about this, Digital Equipment Corporation, 444 Whitney Street, Northboro, Mass. 01532 will be glad to send you a brochure on the subject, called Distributed Data Processing: The Practical Alternative. Ask for Brochure EAQ6782 798/77.

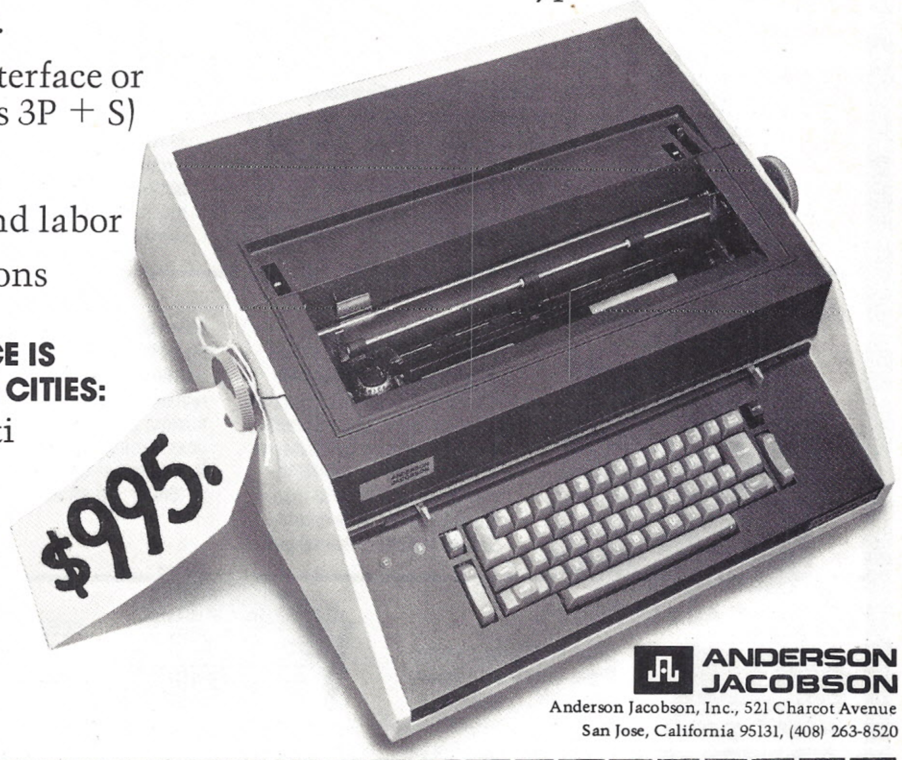
Translation: Is the programmer still a protected specie? (courtesy of Zero-Un-Informatique)

A PROFESSIONAL COMPUTER TERMINAL FOR THE SERIOUS HOBBYIST

THE AJ 841 I/O—A COMPLETELY REFURBISHED IBM SELECTRIC TERMINAL WITH BUILT IN ASCII INTERFACE—JUST $995

Features:

- ASCII code
- 14.9 characters per second printout
- Special introductory price—$995 (regularly $1195). 75% discount over original price of new unit.
- Choice of RS 232 Serial Interface or Parallel Interface (requires 3P + S)
- Order direct from factory
- 30 day warranty—parts and labor
- Nationwide service locations
- High quality selectric printing
- Reliable, heavy duty selectric mechanism
- Off line use as typewriter



AJ 841 WARRANTY AND SERVICE IS AVAILABLE IN THE FOLLOWING CITIES:

Los Angeles
Philadelphia
Hackensack
Columbus
Cleveland
San Jose
Boston
Washington, D.C.
Cincinnati
Detroit
Dallas
Houston
Atlanta
Chicago
New York

ANDERSON JACOBSON
Anderson Jacobson, Inc., 521 Charcot Avenue
San Jose, California 95131, (408) 263-8520

HOW TO ORDER AN AJ 841 I/O TERMINAL

1. Make cashier's check or money order payable to: **ANDERSON JACOBSON, INC.**

   Address your request to:

   Personal Computer Terminal
   ANDERSON JACOBSON, INC.
   521 Charcot Avenue
   San Jose, CA 95131
2. Upon written notification, pick up your terminal at the AJ service office located in one of the above cities. Allow six to eight weeks for delivery.
3. A final check of your unit will be made at the local AJ service office at time of pick up.
4. For warranty or repair service, return unit to designated service location.

CLIP AND MAIL WITH ORDER

SELECT EITHER:
☐ RS 232 Serial Interface
☐ Parallel Interface (requires 3P + S)

Number of units ______ @ $995. each $______

Local Sales Tax $______
Shipping and handling $35.00 each (excluding San Jose) $______

TOTAL $______

NAME ______

ADDRESS ______

CITY ______ STATE ______ ZIP ______

PHONE (____) ______

Can Robots Grow Up?

Glenn R. Norris
President, United States Robotics Society

In the past couple of years newspapers and television have made much of anthropomorphic gadgets that people have built and advertised as robots. Star Wars has impressed us with appealing representations of robots, computer magazines have been filled with both speculative and practical articles on robotics, and books on robot design and construction are selling well. The pursuit of "artificial intelligence" has become a little man's game, to be played freely with personal computing systems outside of the established institutions. One can even buy hardware that "understands" spoken words. Has the time come to protect human society from mechanistic robotic society by passing and enforcing rigorous restrictive laws? Consider the few years remaining in this century; will historians look back on them as part of the Age of Robotics?

Unlikely.

This scepticism may seem peculiar on the part of one identified publicly with the field of robotics, but it means only that the subject is bigger and more interesting than anything that has yet been accomplished. Further, it is not clear that the present level of popular interest will be sustained, because the performance of intelligent machines will fall short of popular expectations for many years to come, while more exciting activities like war, famine and baseball will provide fulfilling satisfaction. The few people who are persistently interested in robotics will plug away for their own private reasons, not because robotics does anything to improve their social standing. In fact, those who persist may do well to keep their interest quiet, certainly restrained, in public.

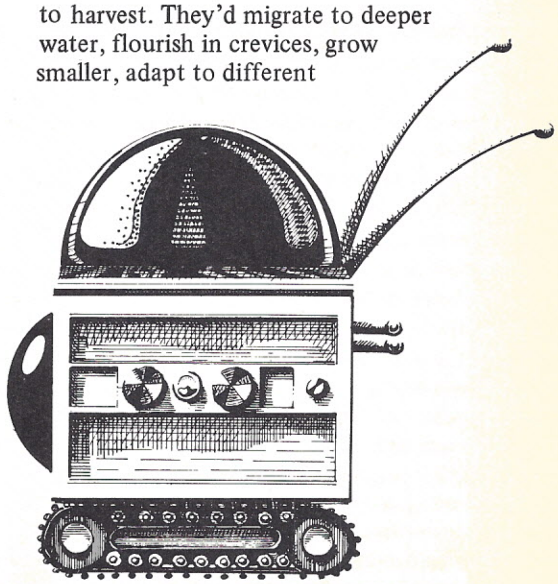
Robotics touches fundamental, ancient mysteries of the sort that stir passion and violence among civilized human beings. For the next two or three decades, robot performance will probably be the best assurance that robots won't be taken seriously. However, as roboticists succeed in making machines simulate human performance, philosophers, politicians, and voters may grow uneasy.

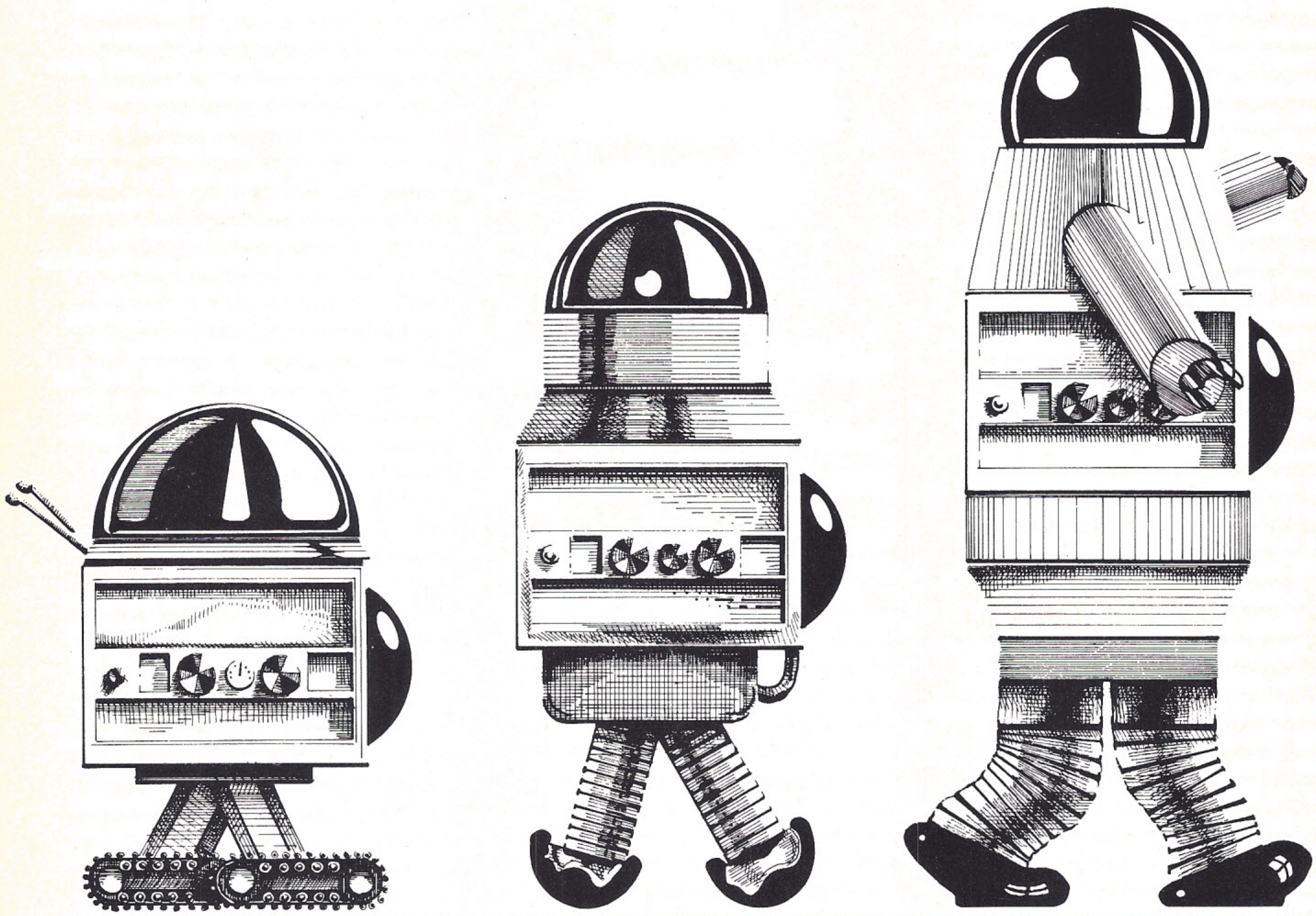
The inescapable fact is that roboticists are working to develop artificial animals. The implications of that are complex, and they lead certainly to eventual conflict. Many things lead to conflict, and we do them anyway – exploration, education, production, marriage – so this alone does not make robotics unacceptable. The problem is that human beings cannot comfortably explain natural living things, but must accept them, because they "are." Artificial living things are even harder to explain, and there is no traditional need to tolerate them just because they "are." Is their destruction just property damage, or is it killing? Can machines really be "alive?"

Living things are all designed for survival and for reproduction. Perhaps that is the "out" for roboticists. They might explain that machines wholly dependent on human attention are not animals and shouldn't be taken seriously. (That is, civil rights movements, anti-robot-vivisection groups, robot shelter groups, stamp-out-robot societies, and the like are all unnecessary.) Still, the machines *will* do upsetting things.

Back in 1956, for example, a chap proposed development of artificial plants for exploiting natural resources in the sea. He suggested that we release large numbers of gadgets that would collect minerals from the waters and the sea bottom, as plants do, and grow. More, the plants would reproduce, creating additional plants that would collect material . . . and grow . . . and reproduce. The technology for this is not unimaginable. John Von Neumann went out of his way to prove that self-reproducing machines are theoretically possible. People would derive benefit from these artificial seaweeds by harvesting them periodically to collect the materials of which they are made. The unharvested plants in the sea would eat and reproduce to make a new crop. There's charm in this, largely because the artificial living things are called "plants." Now, remove some of the charm by thinking about evolution.

You know in your heart that some mutations would occur in succeeding generations of these plants. As in life, where most mutations are fatal, most of the mutated plants would die off. However, a few would survive. Bound to. "Survival" involves continuing to eat and to reproduce. It also involves not being swept up by harvesting machines. Without a doubt, some few of the artificial plants would develop characteristics that make them hard to harvest. They'd migrate to deeper water, flourish in crevices, grow smaller, adapt to different



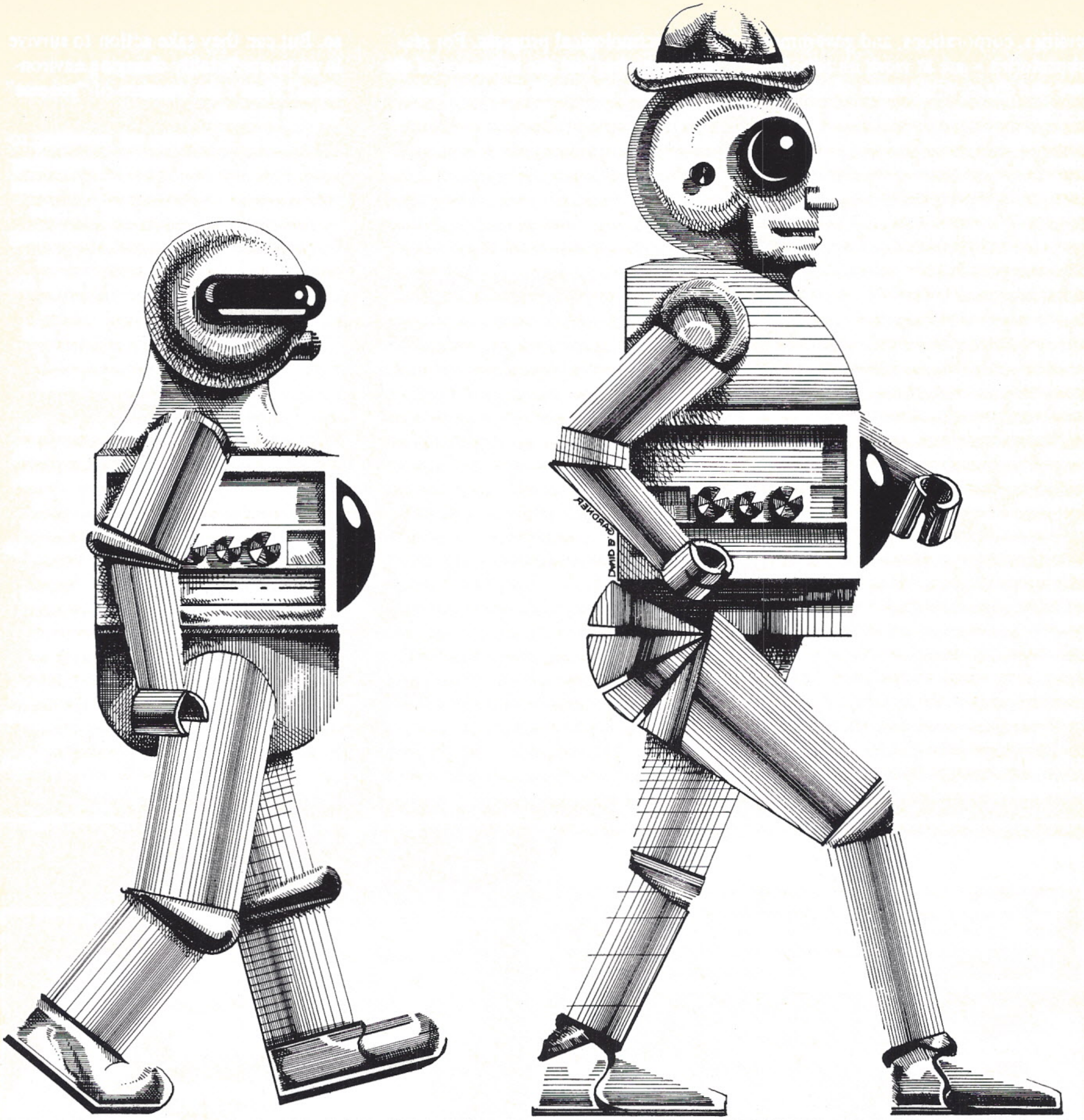


foods, not as a matter of will, but as a report on the realities of being a new species in the ocean, subject to real-world environmental pressures of the kind that altered species in the past.

That is to say, the plants would eventually get out of the control of the people who planted them, competing with other species in the sea, perhaps to Mankind's great advantage, perhaps not. Would Nature care? Does Nature really miss the passenger pigeon or welcome the human being? These questions seem hardly subject to rational resolution, but they are the center of passionate discussion based on faith, revelation, and tradition.

In that case, people were talking about plants, whatever they may really have meant. Roboticists writing now are describing animals. David Heiserman (See "What *is* a Robot?", Personal Computing, July/August 1977) carefully describes robots as devices that must work independently of human control and intervention, making their own judgements in their own terms, to serve their own ends. Ralph Hollis (See "NEWT: A Mobile, Cognitive Robot", BYTE Magazine, June 1977) explains defensively, after describing a technique by which a robot might tap into a large computer system via timesharing, that the robot is not under the control of the big system, but is independent, choosing to call the bigger system at its own initiative. The Heiserman/Hollis robots are designed to seek their own food (electrical power) by searching for electrical outlets to plug into when they get hungry (when their batteries run down). They are "learning" creatures that fumble around their territory, using sensors to perceive objects and patterns, and remembering what they perceive to speed their judgements in the future. Neither Heiserman nor Hollis has described techniques for letting their robots reproduce, but one suspects that they just haven't got to that problem yet, being preoccupied with more pressing short-term matters, like finding ways to keep the robots from toppling over and getting hurt.

These creatures are animals, and wouldn't be very interesting to people



if they were not. Industrial robots, automatic machine tools bolted into place, don't have the appeal of these little robotic creatures that are struggling to cope with a difficult world, taking their chances in changing environments, learning from experience, being killed when they fail to learn well. The mechanical creatures have endearing behavioral traits with which human beings can identify as they identify with kittens, puppies, tortoises, even ants. This is no great novelty; people even perceive endearing behavioral traits in cars.

At this time, the robots aren't maturing into adults. They remain babylike, helpless creatures struggling patiently to cope in a stupid, foolish fashion. The roboticists don't yet know how to help their creatures grow up, but they are working away at the task with diligence that fascinates even the non-technical onlooker. Both the robots and their mentors are interesting.

It is tempting to hope that the machines can be kept in a childlike state, full of ignorant mischief, but no harm. One wishes for a magic incantation, for Asimov's Laws of Robotics, for example, that will keep the robots harmless to Man. Alas, even Man is not harmless to Man. The robots will learn, in time, to do what lets them survive in the presence of human beings. That may involve abject subservience to human wishes and well-being or physical defense against human intervention. Why should artificial life be different from real life? We may strive to make robots benign, but we don't know how. They *will* develop survival traits.

And we cannot ignore the institutional approach to robotics while celebrating the resourcefulness of individual experimenters. (Heiserman has become a professional writer-about-robots, supporting his intensely pragmatic work by earning money from publishers for himself and the projects. Hollis supports his work within the University of Colorado "with personal funds." Incidentally, Hollis points out vigorously that Newt is not his personal product, but that of a group of private individuals to whom he gives appropriate credit.) The institutions – the uni-

versities, corporations, and government laboratories – are at work on robotics here and there, while some of the researchers complain loudly that their work might be used for immoral purposes. As a practical matter, artificial intelligence will surely be employed in weaponry, by the good guys and the bad guys, both. Take your pick.

Considering that insurgent armies are armed largely with weapons captured from the establishment forces against which they are fighting, might it not be helpful to the establishment to equip its troops with weapons that would operate only for masters whom they recognize? Might not booby traps and mines be more effective if they were triggered only by "enemies," not by those recognized as "friends?"

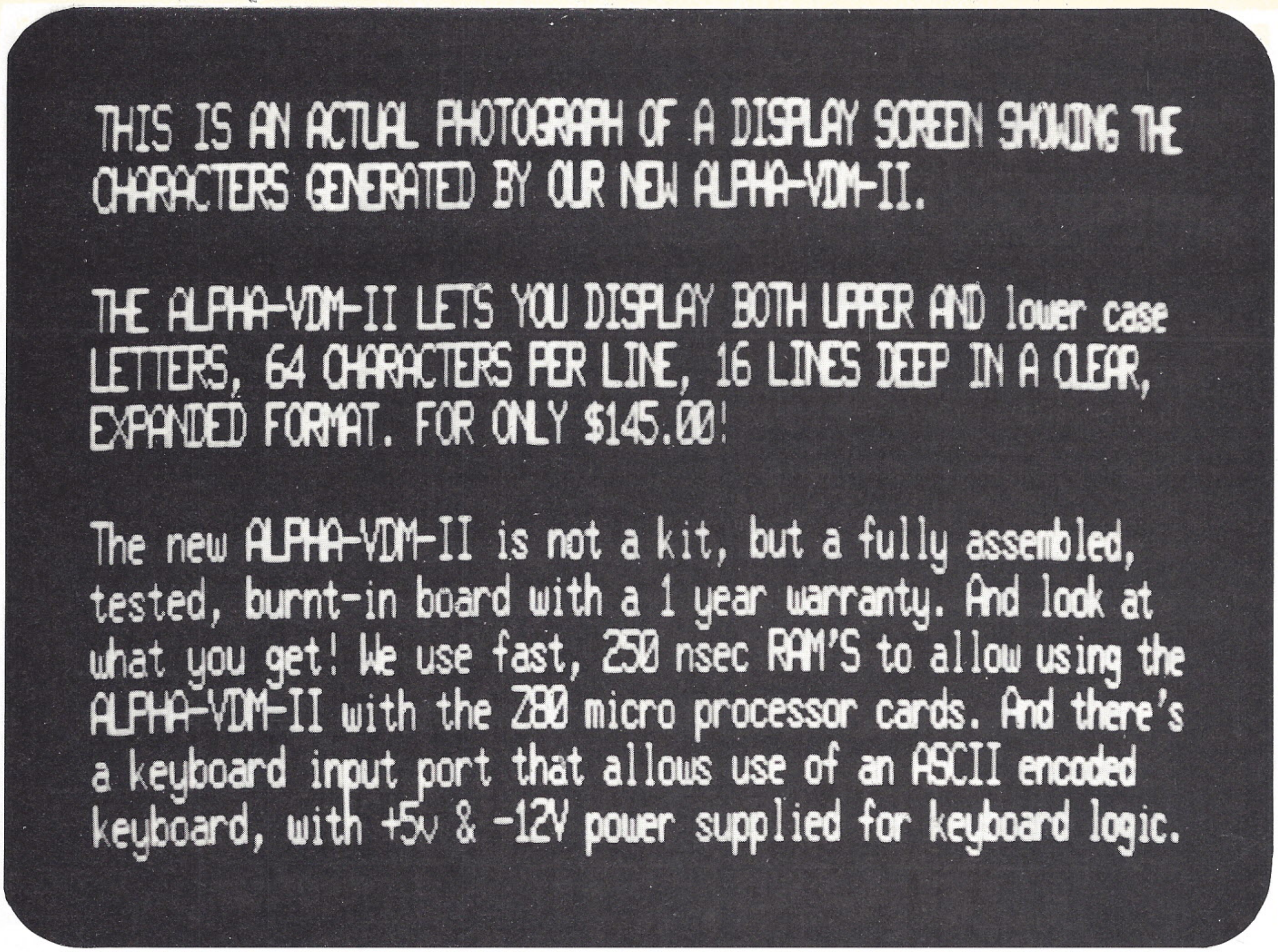
The institutions will be foremost in development of robot miners, for example. Reports are that a first-class miner earns as much as $50,000 to $75,000 a year these days under the warlike, hazardous conditions of hard-rock work. Robot miners with common sense would save lives and money.

There's no certainty, either, that robots will be bitterly fought in "Luddite" uprisings intended to save human jobs from technological progress. For reasons quite beyond the influence of the roboticists, the world may well experience a population "implosion" rather than explosion. Hunger and disease have thinned human ranks before, and this century has no obvious immunity to trouble. Smart machines may be enthusiastically welcomed by desperate small populations struggling to get all the work done.

The hard part is the common sense. That's what the experimenters are working at in small labs, in back rooms, on kitchen tables, in garages. Common sense is hard to come by. Intellectuals surely have no monopoly on common sense; indeed, are suspected by people in general of having less common sense than most. There's no telling where common sense will be developed in artificial intelligence. We can be fooled in this matter by our ability to insert advanced technology piecemeal into robotics systems. Speech recognition, not just of isolated phrases, but of connected speech, seems wholly practical, even economical, in the next half-dozen years. Recorded or synthesized speech can be generated by robots in response to spoken inquiries. The machines act and sound smart, startlingly so. But can they take action to survive in an unpredictably changing environment? That's the measure of "success" among animals.

To some of us who are watching robotics very closely, neither promoting nor discouraging the activity, it seems improbable that robots will become "successful" in this century, achieving the admirable staying power of the cockroach or the opossum. (Hollis observes that he's looking forward to years of intensive work on Newt and his successors, not driving toward a particular end, but striving to learn what is possible.)

Of course, personal wishes for the future do not always correspond with real expectations. The wish (my wish, anyway) is that robots would all be like the Muppets, those created creatures that are looked upon by many as the highest current artistic achievement in the Western World. Muppets are grotesque, but appealing, sometimes stupid, but always thoughtful within their limitations, violent, but not inappropriately, wild, but careful. I wish robots could all be like Muppets, but I'm afraid they'll be like living things in the real world. Come to think of it, what's wrong with that?



The Alpha-VDM-II contains 1K (1024) bytes of random access memory, to which the processor can read or write, just as though the memory were an integral part of the system. As the information is written, the contents of this on-card memory are displayed instantly without interrupting the operation of the processor.

All timing required to generate a standard video signal is provided by a crystal oscillator and associated digital circuitry. Centering of the display on the monitor screen is controlled by drift-free counter logic.

The 1K by 8 static display memory buffer is directly addressable as RAM on the S-100 bus. Displaying data on the screen is accomplished by moving the data to be displayed in the first 512 bytes of the Alpha-VDM memory. Therefore the display update is essentially instantaneous. Output routines can make use of all Memory Reference instruction, including one byte moves. (i.e. MOV M, reg.)

Multiple programmable cursor circuitry is built in. All 1024 cursors can be displayed at one time, and anywhere in the display. Thus, the VDM can display white-on-black or black-on-white — perfect for many video games! The VDM also features EIA Video output for any standard video monitor, or a TV repair shop can easily modify your own set.

The VDM comes with free terminal mode software, designed for teletype replacement. Options include select blinking cursors, text line blanking after carriage return.

Also available: 4K RAM; $107.00, 8K RAM; $197.50, 8K(Z) fast RAM; $217.50, Alpha-VDM; $107.00, Graphics-VDM; $137.00.

Order direct, by check, BankAmericard or Master Charge (Add $1.50 shipping, credit customers give us all the card numbers, please and Ohio residents add 4½% sales tax) or contact us for more information. Kent-Moore Instrument Company, a subsidiary of Kent-Moore Corporation (founded in 1919), P.O. Box 507, Industrial Ave., Pioneer, Ohio 43554. (419) 737-2352. Or, Kent-Moore of Canada, 246 S. Cawthra Rd., Mississauga, Ontario L-A3P2, Canada.

Kent-Moore
INSTRUMENT COMPANY

CIRCLE 15

Although most of our effort is spent in the creation or detection of meaningful patterns, there are times when patterns are a problem — and it's extremely difficult to get rid of them.

Some Comments on RANDOMNESS

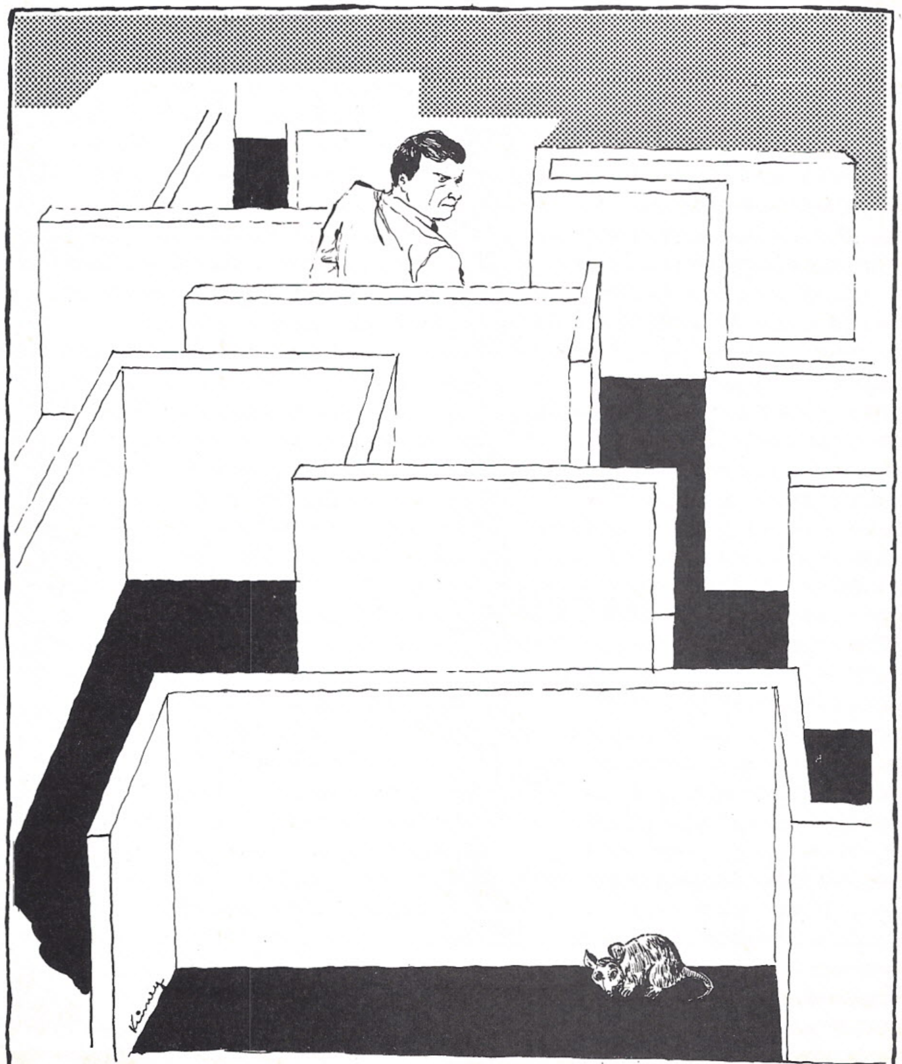
by David Galef

3216532114 . . . . The preceding is a random series, generated, in this case, by rolling a die ten times and recording the results. There is no intentional pattern, no grouping with any particular significance and even if the die had come up ten threes in a row, the series would still have been totally random. What exactly is a random series and how is it produced? These questions are important for today's computer enthusiasts. The science of random numbers fits into many home computer uses: chance programs, probability and even complex game theories have at their bases a randomness concept. Knowing about random series is a must.

In 1955, the Rand Corporation came out with a book composed entirely of five-digit units of random numbers, comprising a million digits in all. No, the programmers weren't crazy — the book was, in fact, welcomed as one of the first almost bias-free collections of random series. In the past, such crude methods of generating random series had included spinning a roulette wheel divided into ten parts, extracting the middle numbers from the areas of English parishes and using old freight way bills. The Rand mathematicians used the sophisticated electronic pulse method to produce random binary digits. The figures were then changed to decimal notation.

Probably the best explanation of why such a fuss was and still is being made over producing a perfectly random series is the difficulty inherent in making one. Many methods proposed have built-in biases and flaws which interfere with true randomness. A typical instance of a not-quite-workable system for generating random series is the one developed by the mathematician John von Neumann. In the method he proposed, the computer selects a random number x digits long, squares the number, extracts the x number of middle digits, then squares the new number, extracts the middle digits . . . in this way producing an infinite series of random numbers x units long. This method, which seems perfectly workable on first inspection, actually has a number of holes in it. An example of why it is inadequate is shown if the computer selects the random number 3792: $3792^2 = 14,379,264$, the middle of which is 3792. The series generated becomes 3792 3792 3792 . . . a lamentably obvious pattern. Nowadays, computers use much more reliable ways to form random series — the haphazard clicks of a Geiger counter registering the decay of subatomic particles is just one of the modern techniques.

One of the curious pitfalls of designing a random series stems from the human inclination to accept only an apparently aimless line of numbers as random. If one of the foolproof methods for generating patternless series is used, and the series created is 33334444, the programmer will most



probably reject the series as not being truly random, when in fact it is. A series starting out 160386974 is far easier to accept as random than 999999999. The correct way of determining randomness lies in one of the most widely accepted definitions of a random series which contains the basic qualification that the next number of the series may be any number: ten percent chance of its being zero,, ten percent chance of its being one and so on. This condition must remain true for the entire series or else the grouping ceases to be totally unspecified. If, for example, the programmer wishes to show a random grouping of ten digits with all numbers represented, the tenth number will always *predictably* be whatever one number is missing from the first part of the series. Randomness goes out the window with such restrictions.

Another interesting concept of randomness, not too well covered under the present definitions, involves the manipulation of a truly random series. Every tenth number of this series is selected and incorporated into a new series. The problem arises over what to call the new series – random or patterned? One way of looking at it would be to say that the series is certainly random: after all, the new series was formed from a patternless series and is almost surely just as random as the original one. The conflicting view, however, has it that selecting every tenth number establishes a pattern; even if the new series looks random, even though it came from a truly random basis, it nonetheless does have a pattern. With the earlier series in hand, the new series is totally predictable. The question of whether the created series is random cannot be simply shrugged off with a pat answer. Such a dilemma involves the very concept of randomness, the element of uncertainty.

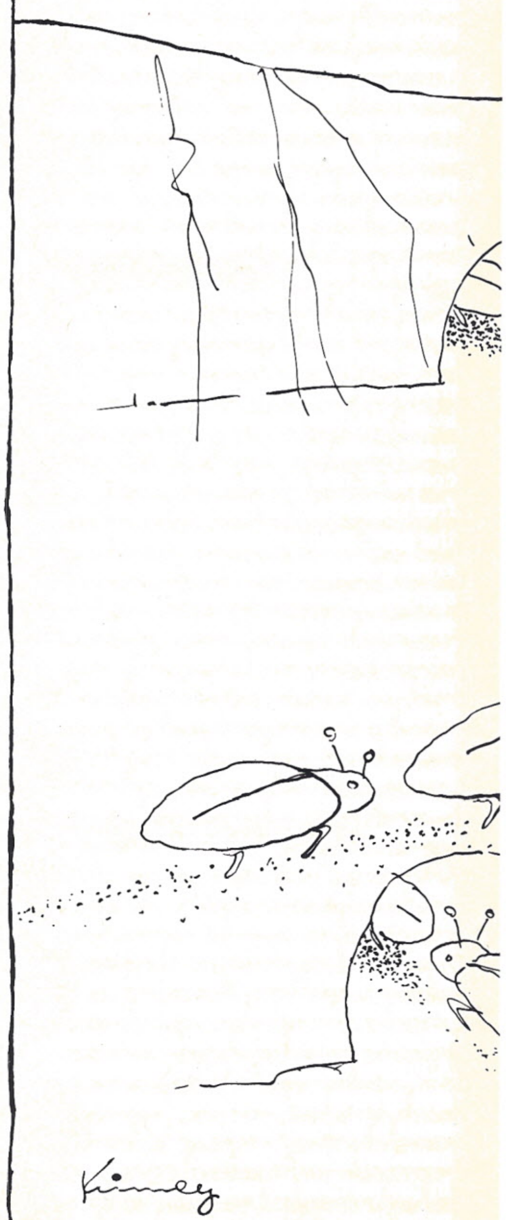
When a programmer uses the computer for any game program involving chance, the random element always comes into play. An example of randomness in game programs occurs in any one of the numerous casino games so popular with the home computer audience. In such games as Craps or Roulette, the entire structure of the program is reduced to pure chance: with Craps, the computer selects, in two successive operations, two random numbers from one to six. Again, it is interesting to note that, even with such a simple application of randomness, biases in number selection can crop up. If, for example, the programmer instructs the computer to choose a real random number from one to six inclusive and then take the integer portion of that number as a die roll, there will be a heavy bias. The game is now crooked: there is little likelihood that the computer will ever "roll" a six-one chance in infinity, in fact. The reason for the distortion is simple enough, though many game programs have such inconsistencies. If the computer comes up with any number from one to two, such as 1.3546 or 1.5842, the die roll automatically becomes one. 2.7980 yields two, as do any other real numbers up to 5.9999; the only way the computer can arrive at six, however, is by actually picking the number six itself. Therein lies the cheat: elevens, among other crucial rolls, are now practically impossible. In this way, impartially random computer programs can be slanted. Don't gamble with them unless you see the program first.

Though first applied to gambling, random theory has now come of age. By this stage it has encompassed quite a few fields, not the least of which is game theory, a complex system of educated guesswork first employed by the United States during the Cold War to outguess the Russians. The study of randomness is now being put to work to describe the countless decision situations in politics, science and business. All of these areas have the uncontrollable random element, the realm of uncertainty which can play havoc with carefully laid plans and therefore must be incorporated into any risky maneuver. Because the forces at work do have some semblance of pattern – sometimes complicated cycles – they can be analyzed with the techniques used for finding patterns in seemingly random sequences. In this way, though the unpredictability factor is still there, options and choices in response to chance events are all prepared. More important, analyzers will at least be able to determine what the maximum probability event will be, and plan for it.

For the personal computing programmer, the goals of a good grounding in random theory don't have to be as lofty as managing international relations or big business; chance game programs and random tie-ins with probability for any number of play-against-the-computer games are simple to program and easy to cope with. For most people, trying to anticipate the moves of an unseen, unpredictable opponent is quite challenging – another random theory application.

BAH

While David Galef's observations on randomness are concerned chiefly with numbers, the subject can be discussed from many different angles, often without getting down to numbers at all. Here's an example in an article written about 1969, before personal computing had come into view.



HUMBUG!

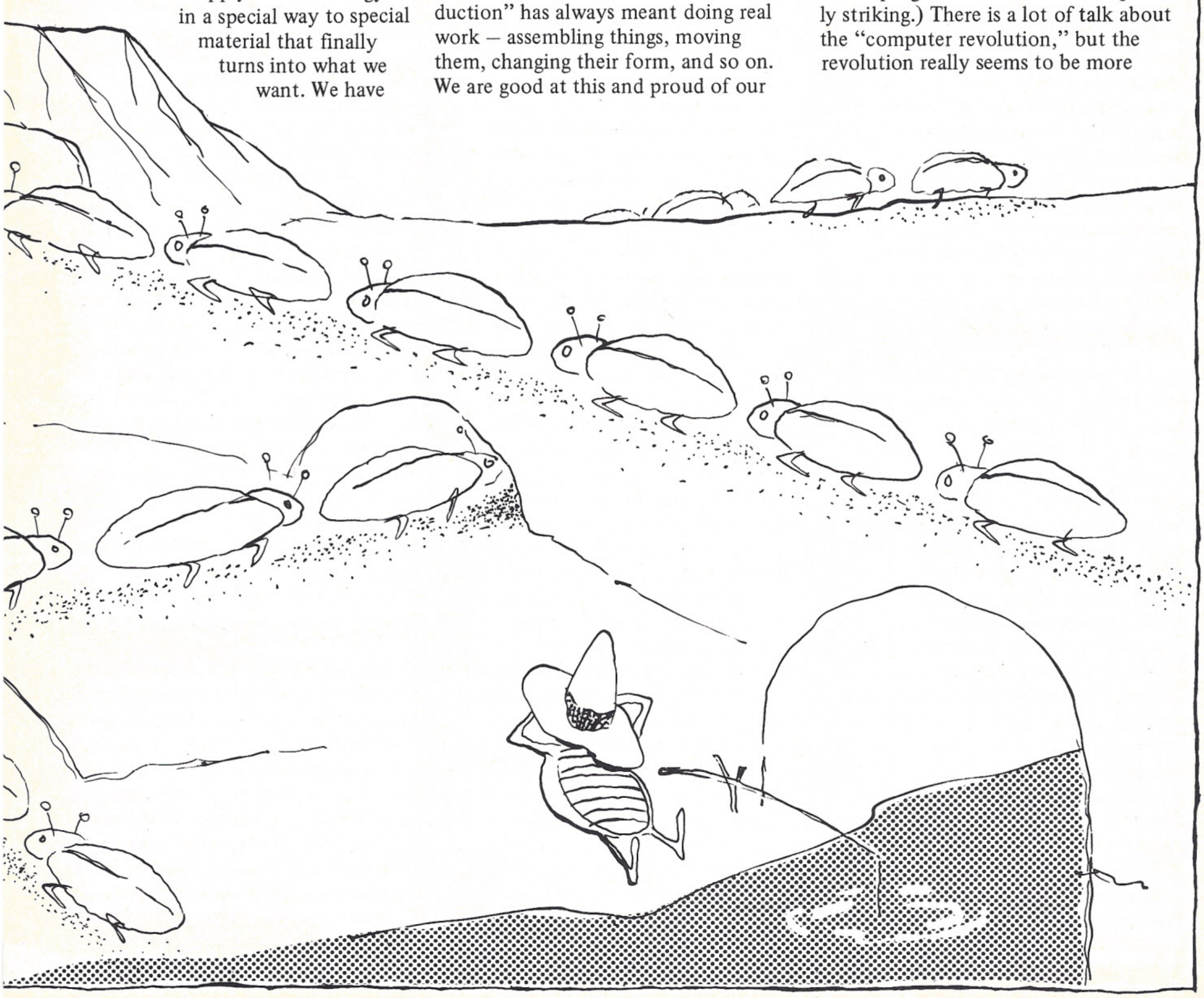
by Nels Winkless

A man we know has developed a strain of bacteria that will eat mothballs and produce aspirin. The odd thing is that it wasn't a chance discovery, but a deliberate job of work. That's what he had in mind when he started.

Bugs have been eating sugar in grape juice and producing alcohol for a long time, but it would never have occurred to most of us to ask a bug to lunch on naphthalene and convert it to aspirin. Traditionally, when we want a quantity of some chemical, we build a lot of special equipment that will apply a lot of energy in a special way to special material that finally turns into what we want. We have trouble with things that we don't thoroughly understand. We are unable to deal with processes for which we can't specify all the steps or materials involved. At least, that's how it *was,* but lately something basic has been changing in technology and the effects show up in surprising ways. We must step back a few paces to see the forest in spite of the trees.

Americans have concentrated on production, on developing not only hardware, but human organizations that are able to produce quantities of desirable things. In our tradition, "production" has always meant doing real work – assembling things, moving them, changing their form, and so on. We are good at this and proud of our abilities. We don't permit ourselves to fool around much with the basic philosophy.

On the other hand, there is a class of important stuff that we do permit people to play with. Within the last generation, we have begun to play on a large scale with information processing systems. Computers are the more-or-less visible product of this play. (Here in New Mexico we have the unusual image of massive computer installations established in an Old West environment. The contrast between progress and tradition is especially striking.) There is a lot of talk about the "computer revolution," but the revolution really seems to be more



broadly based.

It may be that computers are socially acceptable because they seem like working tools. They make interesting marks on piles of paper. Even a computer must not be frivolous if a hand truck is needed to carry its output.

Actually, the computer produces no *thing*. It just juggles information. As a matter of fact, a computer itself isn't any particular thing. That is, every time we change the computer program, it becomes a different machine with a different function. It is not stretching the point by much to look upon the computer as a box of available parts – a do-it-yourself-kit that can be assembled into whatever you want.

More peculiar still, though we must specify the major events in a computer process, a particular job may be done in any of a zillion different ways and computers may actually modify their own programs to pick better ways of doing their work. A man who cannot be comfortable unless he has a firm grasp of the details of the machine's work will grow very uncomfortable under these circumstances. He finds that he is not giving firm commands that will be obeyed unequivocally, but suggesting policies that he hopes will be effective. It's like training a dog act for the circus . . . or a colony of microorganisms for the aspirin factory.

The nice thing about computers is that they let us do jobs that we don't fully understand.

Self-Organizing Systems

The ACCEL computer program developed by Sandia Corporation is a good example. The object of the program is to design layouts for printed circuit cards, starting with the engineer's rough schematic drawing of the the circuit he wants.

The standard procedure is to give the schematic to a design draftsman who fusses with the layout until he is satisfied that he can't do any better. It's a creative job. Some people are good at it; some not. You can't teach people exactly how to do it. All you can do is describe the general characteristics of satisfactory layouts, provide some policies to follow (like: "Don't get conducting paths too close together.") and turn your man loose.

ACCEL works the same way. The computer is provided with some standards and a set of policies and turned loose. It fusses with the layout until it is satisfied that it can't do any better. The programmers who wrote ACCEL do not know in detail what will happen with any particular design or even with slightly different presentations of the same design. They did not provide a formula that is supposed to anticipate any possible circuit configuration, but a set of actions to try and a set of standards to determine whether the actions are working or not. This is a self-organizing system, rather like a colony of microorganisms. The tireless computer just bumbles along until it meets certain criteria, but it bumbles *fast.*

We try to be efficient in commercial processes. In a factory, we discourage random action that does not appear to contribute to production. However, certain kinds of things don't work at all when we succeed in making them orderly.

Helpful Noise

For example, scientists have modeled a nerve net in the computer and the system has the salient features of a real, live nervous system. Among other things, it is subject to epileptic seizure. The seizures occur when some orderly series of events become strongly cyclic. These strong signals overcome weaker processes and influence them to operate in synchronism. Pretty soon the whole system is pulsing in unison. Under these conditions, the nerve net can't respond to outside stimulus. It can't even do its own internal housekeeping. All is caught up in the seizure.

This problem is avoided in the model by adding electrical "noise" to the nice, clean system – not a lot of noise, not enough to saturate the system and keep it from operating, just enough to provide a disorderly counterforce to any strong internal cycle that might otherwise seize the system.

"Noise" is random, irregular, not systematic, not planned, not predictable in detail, not cyclic, not simple.. With noise, the neural model works. Without noise, it does not work. No opportunity has yet developed to test this idea with epileptics – equipping them with neural noise makers – but the idea has been discussed.

In nonbiological cases engineers are adding noise to digital telemetry to improve the quality of the information retrieved from inconvenient places like Mars. In fact, they are adding "optical noise" to pictures being processed in computers. The additional disorder created by the noise permits us to achieve desirable objectives with only a small fraction of the raw data we would require if we kept our signals clean.

In one case a noise system is doing real work, not just playing with information. The Mowbot automatic lawnmower cuts grass reliably without doing anything systematic. The design was lifted from Nature, of course. The model was the one-celled paramecium. A paramecium is able to clean out all the food in a drop of water without being very smart. All he really knows is that he can't pass beyond the edge of his water drop. When he gets to the edge, he backs off – but not quite straight. He backs off at a slight angle. Thus, his movements are random (noisy) with respect to the shape of his universe, the drop of water in which he lives. It doesn't sound like an efficient way to search for food and it isn't, but a paramecium doesn't have a whole lot else to do. This rambling eventually carries him to food if there is any in the drop.

The Mowbot lawnmower lives in a similarly restricted universe. The boundary is buried signal wire that the machine can detect. It knows enough not to cross the wire and it backs off at an angle that makes its movements random with respect to the shape of the lawn. Sure enough, it eventually gets to all of the grass. Surprisingly, the efficiency isn't bad – about 25%. That is, it takes Mowbot about four times as long to mow all the grass as it would take you to do the job, assuming that you were 100% efficient and worked systematically with no time out for beer.

The Mowbot doesn't have a whole lot else to do and it doesn't mind snuffling around the yard all afternoon. Fortunes have been lost in the effort to build automatic lawnmowers that do something systematic. This one just bumbles, but it really works.

The Bug Factory

The computers and lawnmowers are creeping up on us, demonstrating the practicality of systems that work randomly-with-a-policy. Again, this design philosophy is taken from Nature. As we understand it better, we are starting to exploit natural systems directly in new ways. This chap with the mothball/aspirin bacteria . . . he and his colleagues have a stable of performing bugs.

More than that, they have a point of view on the whole matter that doesn't sound like either old fashioned biology or old-fashioned engineering. They operate on the theory that all chemical reactions that can take place *are* taking place in every cubic foot of soil. It is stretching this a bit to include Sahara sand as soil, but by digging in your back yard in California, Louisiana, or Connecticut, you can probably obtain a Universal Chemical Factory of your very own. It isn't going to do you much good unless you are a microbiologist, but properly informed and equipped people can convert a spadeful of dirt into a commercial chemical processing plant.

This isn't entirely new. Pasteur won the hearts of winemakers by doing kindly things with yeast. Pharmaceutical companies use molds to produce vats of antibiotics. However, this new approach is fundamentally different. People who make wine are concerned chiefly with having good, pure strains of yeast that will do exactly the same thing to the same kind of juice every time. They want to keep their existing bugs happy, healthy, and hardworking. The pharmaceutical people feel the same way about their existing stables of bugs. They hope fervently and search endlessly for new microorganisms that will produce desirable products. The products they want tend to be long, complex protein molecules with a bunch of special characteristics. True, an organism somewhere is probably making exactly what they want, but finding him is not as simple as running a help-wanted ad. The traditional search method has been to examine microorganisms one at a time – thousands of them – until one is found that produces a desirable product.

The new school doesn't necessarily search for a completed product. They may want a complex protein, all right, but they first determine what they want, then look for a bug that does part of the job, producing something relatively simple that can be used by another bug to carry the work forward another step . . . and so on. Somewhere down the line, the last bug absent-mindedly completes the desired product. The job is done. All is well.

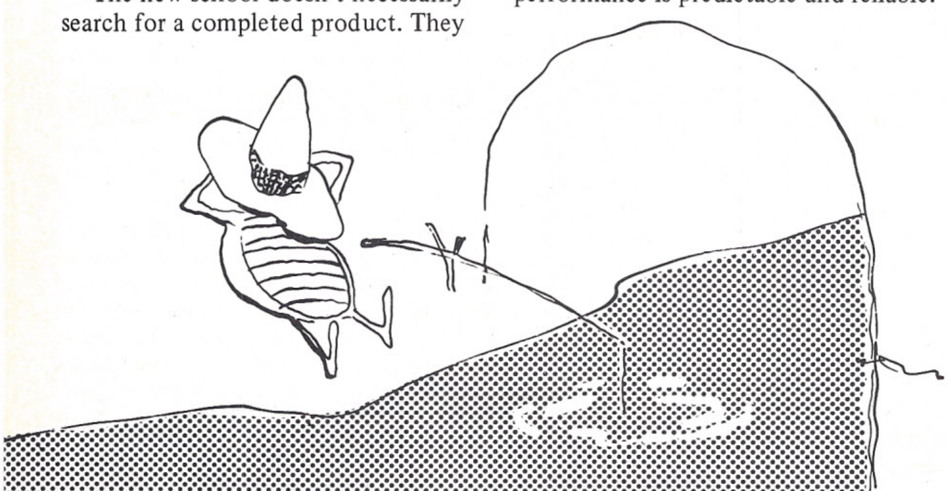
As a matter of fact, one can tinker with this production line nearly at will, substituting bugs that produce just slightly different products – an extra hydroxyl group here, a chain instead of a ring there. Indeed, our informants are commercially designing enzymes to customer specification and developing the microbial production lines that supply the enzymes.

We may look on the microorganisms as production machines, each performing some particular task. Though we don't really know how they work, we can improve these machines. We can develop strains of bugs for special jobs just as we can develop strains of dogs with long hair and horses that run fast.

This field is bioengineering. It's new and its potential is enormous. In the cloudy future, we get some glimpses of very large-scale applications – oil refining, mineral processing, food production and conversion.

These systems are very noisy because the bugs are doing a lot of things that don't contribute directly to production. However, this to-us-random activity keeps the microorganisms alive, lets them deal with problems we don't even detect, and permits them to serve us incidentally. We may think of the pot of bugs as a sort of do-it-yourself kit, like the computer.

Add bugs to the pot, feed them, arrange for influx and outflow, and let them do what they will. Their overall performance is predictable and reliable. It doesn't matter much if a few bugs take time off. Changes in diet or conditions will change the product – or the system may adapt itself to the changes and continue to produce.



Random Reports

It is difficult to enumerate many examples of this changing philosophy, but your practiced eye will spot more and more.

Another case – when jet airplanes first came in, the old reliable cockpit instruments failed, constantly sticking and giving false readings. Jets are too smooth. Piston-driven craft rattle and shake with mechanical noise. The smooth jets simply don't hammer the dry bearings in the instruments enough to let them work. The answer was to install vibrators on jet instrument panels to make up for their nice, clean performance by adding noise.

There seems to be no formal school of engineering that speaks favorably, or even dispassionately, of using systems that operate at-random-but-with-a-policy. There is little noise among engineers. Built-in disorder seems morally offensive to most of us. Practical disorderly systems tend to be discovered, not invented.

The Japanese discovered one a few years ago. An office worker was fired because he often became falling-down drunk on the job. He was vexed by this turn of events because, he insisted, he was a teetotaler.

His word was doubted, but close observation showed that he spoke the truth. Closer observation showed that a cheerful colony of microorganisms in his digestive system was fermenting what he ate and supplying him with home brew.

Antibiotics worked a cure. It is not recorded that he was entirely glad.

Old Paul Honore had wished aloud for years that he could obtain a bucket of bugs that would scrub floors for him. He wants to dump them out, let them slurp around until the floor's all clean, then beat them back into the bucket with a whip and a chair. If you spot this phenomenon, please report. The market may be larger than just Paul.

Then too, we have a supply of lead that would be much more attractive if we could convert it to gold . . .

Here in the Southwest, we're unusally sensitive to development of mineral resources.

they're here!

the new HEATHKIT® low-cost personal computing systems

The new VALUE-STANDARD in personal computing systems! Heathkit computers give you the power and performance to go wherever your imagination and programming prowess take you. They're designed to get you up and running fast, interface with I/O devices easily and quickly, accept additional memory and I/O devices, store and retrieve data with speed and accuracy, respond to your requests with lightning speed. They offer complete mass storage capabilities, power and reliability for any programming application, and they're priced low enough to give you real VALUE for your computer dollar! We've told you they're the ones you've been waiting for — here's why!

These Heathkit computer products are "total system" designs with powerful system software already included in the purchase price. They're the ones you need to get up and running fast. And they're backed by superior documentation including easy-to-follow step-by-step assembly and operations manuals, and service support from the Heath Company, the world's largest and most experienced manufacturer of electronic kits.

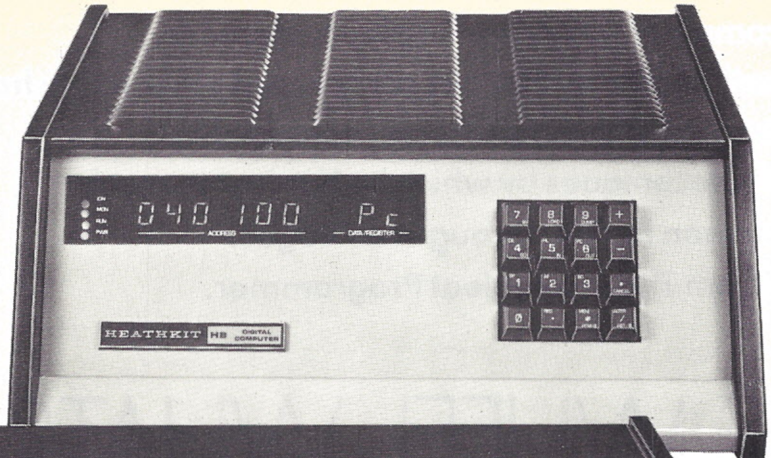
NEW H8 8-Bit Digital Computer. This 8-bit computer based on the famous 8080A microprocessor features a Heathkit exclusive "intelligent" front panel with octal data entry and control, 9-digit readout, a built-in bootstrap for one-button program loading, and a heavy-duty power supply with power enough for plenty of memory and interface expansion capability. It's easier and faster to use than other personal computers and it's priced low enough for any budget.

NEW H11 16-bit Digital Computer. The most sophisticated and versatile personal computer available today — brought to you by Heath Company and Digital Equipment Corporation, the world leader in minicomputer systems. Powerful features include DEC's 16-bit LSI-11 CPU, 4096 x 16 read/write MOS memory expandable to 20K (32K potential), priority interrupt, DMA operation and more. PDP-11 systems software for fast and efficient operation is included!

NEW H9 Video Terminal. A full ASCII terminal featuring a bright 12" CRT, long and short-form display, full 80-character lines, all standard serial interfacing, plus a fully wired and tested control board. Has autoscrolling, full-page or line-erase modes, a transmit page function and a plot mode for simple curves and graphs.

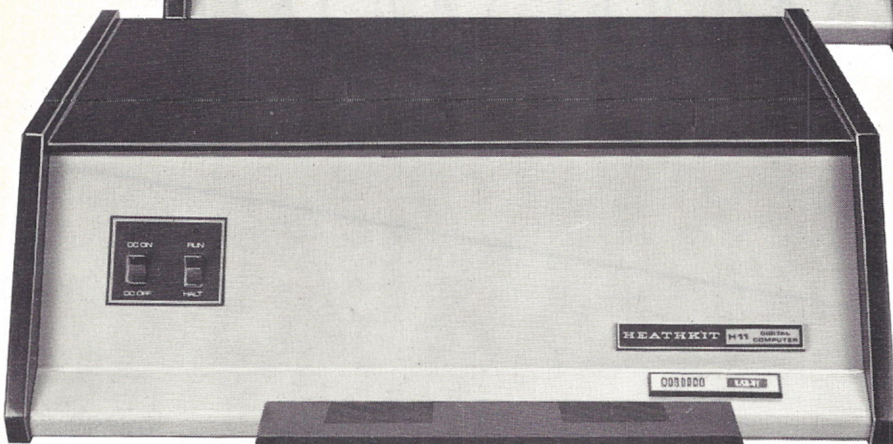
NEW H10 Paper Tape Reader/Punch. Complete mass storage peripheral uses low-cost paper tape. Features solid-state reader with stepper motor drive, totally independent punch and reader and a copy mode for fast, easy tape duplication. Reads up to 50 characters per second, punches up to 10 characters per second.

Other Heathkit computer products include a cassette recorder/player and tape for mass storage, **LA36 DEC Writer II keyboard printer terminal,** serial and parallel interfaces, software, memory expansion and I/O cards, and a complete library of the latest computer books. The Heath User's Group (HUG) provides a newsletter, software library and lots more to help you get the greatest potential from your Heathkit computer products. We've got everything you need to make Heath your personal computing headquarters, send for your FREE catalog today!



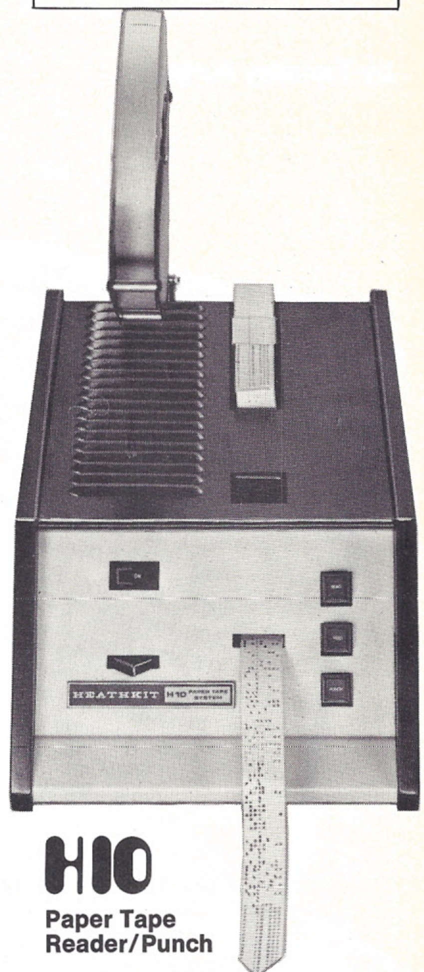
H8
8-Bit Computer
$375 Kit

Also Available: the famous LA36 DEC Writer II Keyboard Printer Terminal only $1495 (Assembled)!



H11
16-Bit Computer
$1295 Kit

H9
Video Terminal
$530 Kit



H10
Paper Tape Reader/Punch
$350 Kit

FREE!

HEATHKIT CATALOG

Read all about our exciting computer systems and nearly 400 other fun-to-build, money-saving electronic products in kit form.

Prices are mail-order FOB, Benton Harbor, Michigan.
Prices and specifications subject to change without notice.
Heath Company, Dept. 352-350 Benton Harbor, Mi 49022

HEATH
Schlumberger

Heath Company, Dept. 352-350
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog.
I am not on your mailing list.

Name____________________

Address____________________

City______________ State________

CP-126 Zip________

CIRCLE 18

In his struggle to learn computer programming by the famous, inefficient cut-and-try method, the author has progressed uncertainly from computer assembly of limericks, through recipe manipulation to a searching study of the techniques by which he has lost so much money playing craps between flights through Las Vegas. Here is the latest report from The Incompleat Programmer.

AFTER THE WHEEL, WHAT?

by Timothy Purinton

June 16, 1977

Dear Dan --

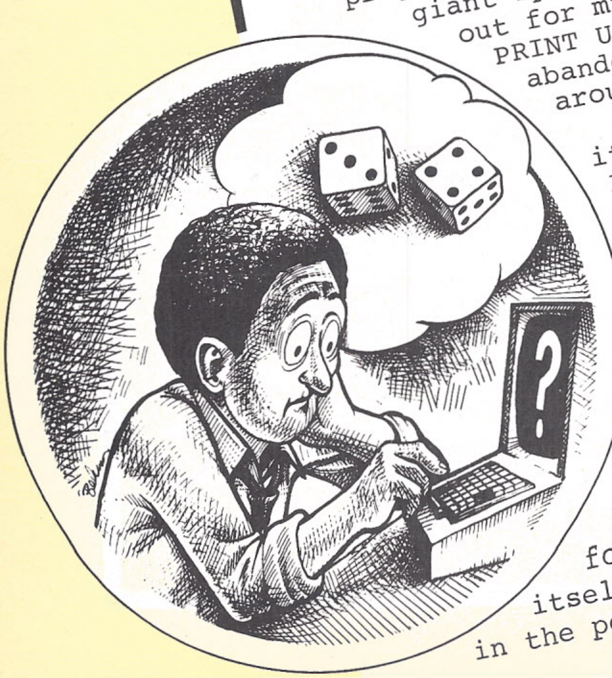
I'd like to believe that the restrained enthusiasm with which you acknowledged my achievements in BASIC Self-Taught(Electronic Tar Baby, PERSONAL COMPUTING, Vol. 1 No. 5) was a criticism of my somewhat flavorless spaghetti and not of my progress toward programming. You may recall I never could get a grasp on the New Math when you brought it home in your earliest grade school years. So though you're a Fortran/Cobol expert now, you wouldn't patronize the old man in his earnest efforts to learn this new trick -- would you? Lemme tell you what I've done for me lately.

As you know, Dave Bunnell finally dropped the other (Spaghetti Basic, PERSONAL COMPUTING, Vol 1 No. 3), revealing his own neat program for calculating quantities of ingredients needed in a giant spaghetti cookfest. Didn't tell me much I hadn't doped out for myself except the form for printout, with its nifty PRINT USING rackup. I haven't yet tried that, and now he has abandoned me again -- I'm on my own, blindly feeling around this elephant.

Somebody might want to tell me that I'm doing it the hard way. Edging into a little programming, I mean, by experimenting, teaching myself -- as opposed to studying books/magazines, or taking lessons or tutoring. But I'm here to tell you that, BOOOYY, YOU REALLY LEARN IT if you have to *invent* it.

Every day since Saturday-last (skipping Sun-Mon when the store was closed) I've wormed my way into Gene Murrow's Computer Power & Light and worked on another problem I've given myself. I'm trying to bui a general program for easy calculation of the odds/chances-of-success in certain craps propositions (and other arithmetic gambles such as roulette).

Yesterday I had to be bounced off a machine to make way for the store's legitimate business, and today the machi itself fought me, almost breaking my spirit. Something hayw in the power supply (building under construction nearby on the



circuit), and even the BASIC kept bombing. I must have had to re-load BASIC ten times, from cassette, and then hand-feed my own program-half-built. No sophisticated taping of my own program for me; not yet, not till I've put something together on the CRT and managed to make it run a little. I don't yet even know how to transfer my program to tape.

Anyway, I'm trying to set up (for hardcopy printout) a neat-looking computer statement of -- say -- the number of progressive bets necessary to reduce a one-in-six shot to a case of 99.5% probability of success . . . and to reckon the minimum investment necessary to be that sure of making a profit or at least getting your money back.

Now, if you're still with me, let me give you an advance flash: I'm leading up to my NEW DISCOVERY, comparable in magnitude and significance with my previous discovery that under certain circumstances it's proper to affirm that T=T+1, which is obviously ridiculous.

Suppose we're working on that on-in-six problem. You're standing at a craps table in some trap in Vegas, and you bet a dollar on Any Seven, a one-roll bet. Given the 36 possible combinations of two dice, you have 6 ways to hit a winner,30 ways to lose. The house doesn't give you straight mathematical odds -- after all, they have to pay the overhead and make their profit -- but it does pay you five for one, your dollar and four more, if you hit. Obviously, if you stand there risking a dollar per roll, you'll probably lose six for every five you get back, and that's the name of the game, but no fun.

So you mean to bet *progressively,*increasing your bet by a little each time you lose, and cutting back to a single unit each time you win. Say arbitrarily that you'll increase your bet by at least a dollar each time you miss:

First bet, $1. If it hits, your profit is $4.

You missed? Bet $2. Your profit on this, if it wins, is $8 -- minus the $1 already lost, for $7 net.

Another miss? Bet $3. Your profit this time, $12 -- minus the $3 already gone, for $9 net.

You can do this in your head, without even pencil & paper, let alone a computer. You find that you can chase Any Seven this way through eight losing tries, and if you manage to hit on the ninth try, you break even -- the investment and the return both being $45.

Now comes the snag, and the EYEOPENER in the self-education of Father Fumbles, the Would-Be Programmer: a bet of $10 on the nest roll would return only $50 . . . and by then the cumulative investment is $55.

HOW CAN WE GET THE COMPUTER TO HANDLE THAT? In even dollars, the way Vegas does business? Next bet must at least equal one-fifth of the new total investment (present investment plus next bet). The sides of the equation seem to be defined one in terms of the other.

My program said, as far as it went --

```
10 PRINT "BET #  $AMT  $INV.  $PAYOUT  $NET
20 B=B+1     (if this Compal 80 has never heard previous
              mention of a variable, it assumes it's Ø.
30 A=A+1     (same here. First $AMT is Ø+1.)
40 I=I+A     (ditto the invested $ -- Ø+1.)
50 P=A*5     (given payout at 5 for one)
```

```
60 N=P-1    (if this bet pays out, Net is $P-$I)
70 PRINT B;A;I;P;N    (to let us see it)
80 GOTO 20  (and develop the progression)
```

And if I'd ever run it, what would have flashed by on the CRT would have been --

BET #	$AMT	$INV.	$PAYOUT	$NET
1	1	1	5	4
2	2	3	10	7
3	3	10	20	10
4	4	10	20	10
5	5	15	25	10
6	6	21	30	9
7	7	28	35	7
8	8	36	40	4
9	9	45	45	0
10	10	55	50	-5
11	11	66	55	-11
12	12	78	60	-18

Obviously going down the tubes fast. Reach in and stop the exercise. (Hit CONTROL and C at Compal.)

It's easy enough to see that Bet #10 has to step up farther from #9 than by just $1. A $3 step would do it -- $12 yields $60 against an investment of $57. But how to get the program to handle it? Five times Something must be at least as big as Investment plus Something. Baffling. Mortifying. Four days at the console (well, not full days, and with BASIC bombing . . .) and a lot of near-sleep, and time here at my desk at home . . .

(And I'm lying in saying that the CRT would have shown those neat columns. I haven't yet tackled the TAB system I've heard about, and haven't tried to apply PRINT USING, which should work. Meanwhile, the calculations are killing me. . .)

Finally today I saw the light.

I knew that any increase in the increment of the rising bet would add to the amount invested. So I built a loop, and tried adding a dollar at a time to each, the A and the I. This was cued-in by an IF...THEN covering the possibility that the payout P, as happens at Bet #10, might not be large enough to cover the investment if the step is a single dollar. See? I'm sneaking up on an answer a digit at a time -- like the big boys.

Insert and add --

```
65 IF N<0 THEN 90
90 A=A+1
100 I=I+1
```

But we don't PRINT that yet. We're just trying it on for size.

```
110 GOTO 50
```

Now the statement at 50 has a new value of A to work with to arrive at P. The first time through this digression, A will come back as 11, and I as 56. At line 50 now, P is valued at 55. Line

60 subtracts I, now 56, from the new P and comes out with a Net of -1. The new line 65 asks, Is that Net less than zero? and if so, go add another digit to each -- that is, go back to 90 for another goosing. Now try it: A is 12, I is 57, P will be 3, and that's +3. Okay, you may print that as Bet #10 --

10 12 57 60 3

It ran!

In the few moments when the construction crew down the block wasn't draining power from my machine and blowing my BASIC and everything, IT RAN!!! Actually, I put in a Don't-Go-Crazy statement -- IF A>500 THEN GOTO 1000 END. This one-in-six shot gets to $418 in 26 tries, and the Investment is $2090. The next step is a big one, too big to keep the $AMT within the usual $500 house limit.

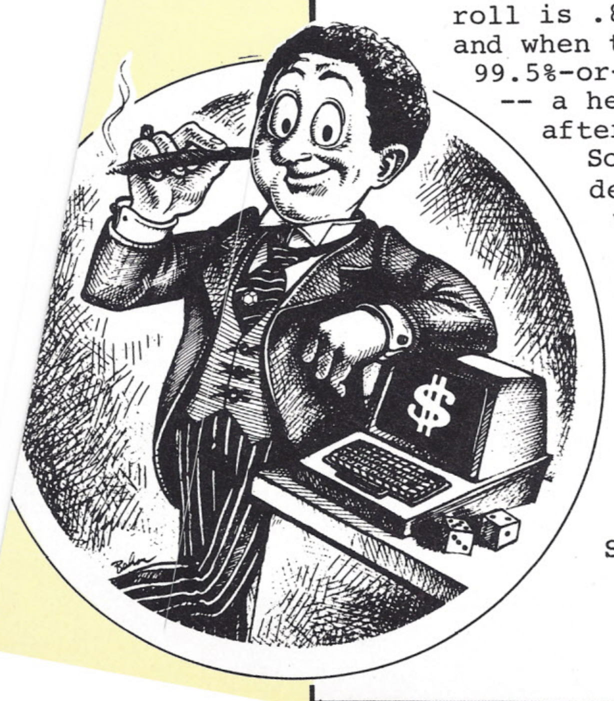
(And a separate calculation -- .8333↑? -- tells me that probability of hitting Any Seven doesn't get to more than 99.5% (actually gets to 99.5777%) until the 30th bet.)

When I finally got that 65, 90, 100, 110 loop straightened out, and had my Compal-80 working on the problem, what fun! I watched it speed through the early easy answers . . . and then, as big-enough bets got farther and farther apart, it would sit thinking between printings --

A=1, adding a tentative buck to the bet unit . . .
I+1, adding one to the investment record . . .
hurrying up to multiply
A*5, to calculate a new P . . . subtracting P from N . . .
making his comparison, N vs Ø . . .
disappointedly running to add another to each A and I,
multiplying and subtracting and comparing again . . .

and finally triumphantly reporting to me when it had found the bet just big enough to make the grade. It took several seconds to work through each calculation by the time it had reached the 26th bet, at the $418 level.

Funny. I thought these rascals actually add and subtract only, as a way of life, and never truly multiplied or divided. But I could tell that the calculation by which he figured the improving chance of hitting with additional rolls was duck soup for him. My formula for that: the chance of missing seven in one roll is .8333, in two rolls $.8333^2$, in three rolls $.8333^3$ . . . and when the result gets down to less than .005, you've gained a 99.5%-or-better chance of hitting. As I've said, that's at .833330 -- a heap of money to risk in the hope of breaking even, any time after the 9th bet.

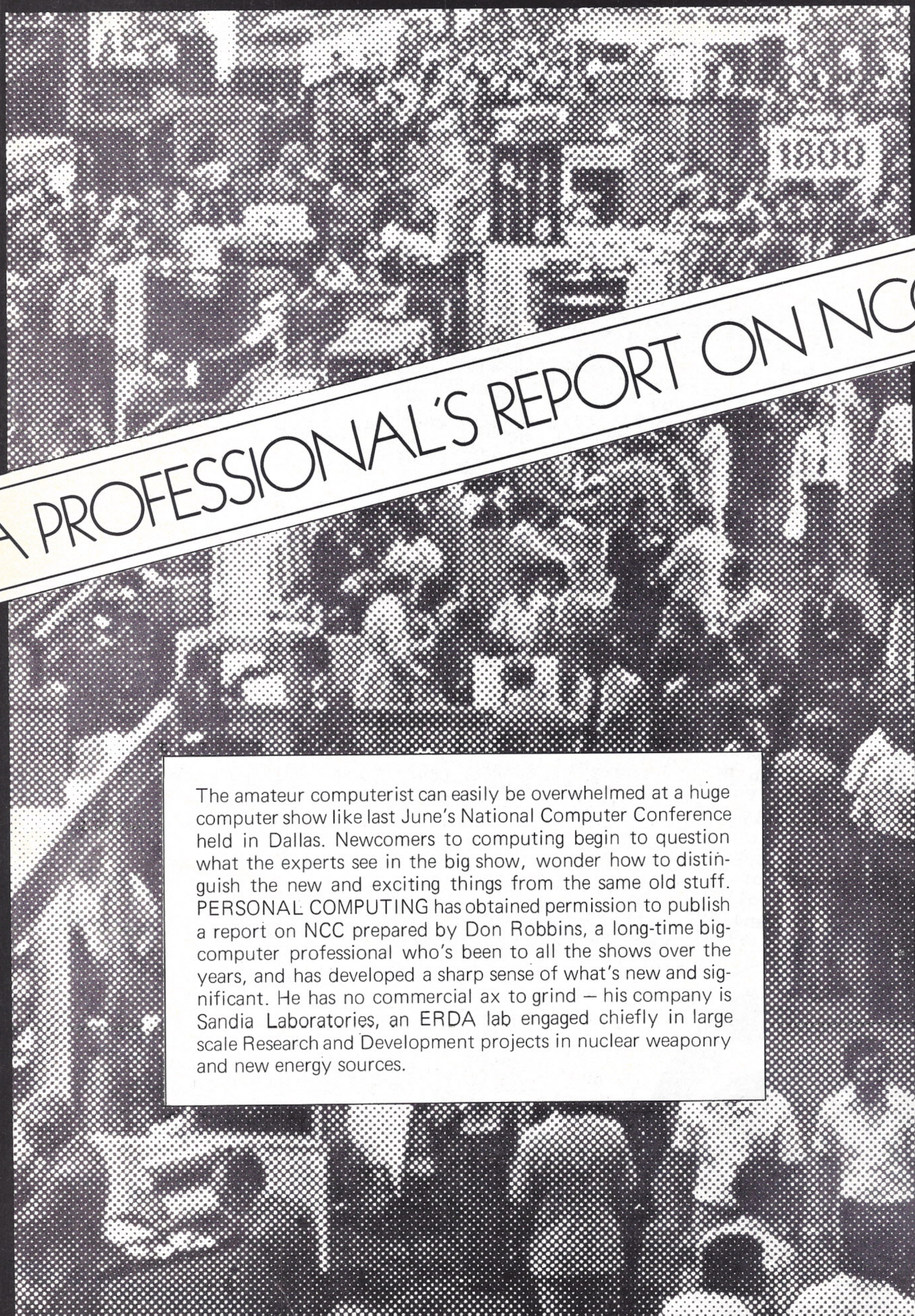


So I've discovered something again. But my feeling of delight is dampened by the awareness that I'm hacking my way through underbrush while a smooth eight-lane highway parallels my course all the way. I know that there are FOR/NEXT loops somewhere beside me, and subscripts, and an EDIT mode in this BASIC . . . and my Brute Force approach is chewing up my life. I'm going to break down and buy a book, and study the Compal manual, and begin to take advantage of the work already done by better men than I. If I can put together a program that tests a craps system, for instance, there's a commercial application I can think of. I'm going to lose my strictly-amateur standing.

Sad, but we must never look back.

Keep 'em calculating --

A PROFESSIONAL'S REPORT ON NCC



The amateur computerist can easily be overwhelmed at a huge computer show like last June's National Computer Conference held in Dallas. Newcomers to computing begin to question what the experts see in the big show, wonder how to distinguish the new and exciting things from the same old stuff. PERSONAL COMPUTING has obtained permission to publish a report on NCC prepared by Don Robbins, a long-time big-computer professional who's been to all the shows over the years, and has developed a sharp sense of what's new and significant. He has no commercial ax to grind — his company is Sandia Laboratories, an ERDA lab engaged chiefly in large scale Research and Development projects in nuclear weaponry and new energy sources.

The 1977 National Computer Conference was held in Dallas the week of June 13, 1977. It was the largest computer event ever held, exceeding the previous biggie which was the NYC meeting. Over 44,000 people registered and there were over 350 exhibitors present. In Texas, of course, they were not surprised at this being the biggest show ever. The true reason no doubt is the fact that the conference chairperson was a woman, Dr. Portia Isaacson.

The general feeling at the conference was upbeat, reminiscent of the zesty conferences of the 1960's.

The keynote speaker was Mr. Mark Shepherd, Jr., of Texas Instruments. He is a 54-year-old native Texan who went to SMU. He is really a believer in the changes that microprocessors (MP) have and will make in the world. His theme was that the MP can help the service industries increase their productivity. He said that an increase of 2% in the country's productivity would reduce the unemployment in the country to about 1%. His reasoning on achieving the overall 2% is as follows: The nation's economic activity is made up of about 1/3 manufacturing and 2/3 service. Increasing productivity in manufacturing is hard, but an increase in productivity of 3% in the service sector will result in a 2% overall increase. Shepherd also said that there are perhaps 1 million in the country now who have or can program. To fill the gap in placing MP's everywhere, he foresees software in firmware. He believes the MP of the future will have a solid state ROM and bubble memory for the non-mechanical disk equivalent.

future computers

There was a session on future computer architecture with an all-star cast, featuring among others the brothers Amdahl, the professional gadfly HRJ Grosch, and Harlan Mills. Some of their words of wisdom:

. . . The successful big mainframes of the future will be designed using the chips mass produced for MP's.

. . . Technology advances are the drivers of the computer revolution.

. . . Technology is galloping along, but software production really hasn't improved too much in the last 10 years. Looking at this situation selfishly, programmers will always have a job.

pattern recognition

I attended a good session on pattern recognition. To show what the magnitude of the problem is one speaker said that a computer word is the unit in numerical analysis – 32 or 36 or 48 or 60 or 64 bits. The item of interest in image processing is typically 1000 x 1000 pixels of 9 bit intensity or about 10^7 bits. And, of course, that really is the problem – in speed, in memory requirements, in I/O bandwidths, in good software, in the ability to interact. A possible solution is to build special purpose (but large) computers to do special tasks. For instance, CDC built a special computer for Wright Patterson to look for changes (objects added or substracted) in aerial views. The air force said the special purpose computer will process a frame for 3 1/2 cents. The equivalent task on the 6600 takes 300 dollars.

lots on micro processors

One of the big themes of the NCC is the microprocessor explosion. Actually, there are many parallels to the start up of the computer business itself some 25 years ago. Much of the programming is done in assembly language and the size of programs is limited. However, since past is prologue, it is a certainty that memory size will increase and that higher level languages will be available.

There were several sessions on software language which have been developed for the MP, as well as the installation of languages such as BASIC on the MP.

Easily the biggest segment of the products on display concerned output, both hard and soft copy. For hard copy, the speed range is from 10 cps to 21,000 lpm. The prices range from about $1,000 to $300,000.

The two methods of printing are impact and non-impact. Two commercial realizations of older capabilities are both sanctified by IBM, the laser printer (IBM 3800 document printer) and the ink jet printer (IBM 6640). The laser printer, represented by Honeywell, Siemens and IBM, uses the Xerographic drum with the image created by the laser (which permits a forms flash also). The ink jet printer has been around a number of years. However, the microprocessor plus IBM engineering have made the ink jet printer possible. Another interesting use of the ink jet was a color plotter displayed by Applicon.

Both the ink jet and the laser printer of course may be used for high precision graphical hard copy in the future. For instance, the IBM ink jet printer uses a 24 x 40 matrix to form its characters.

In the soft copy devices, there was quite a range of intelligence added to the CRT's. Datagraphix had a CRT with 132 characters per line.

There were several plasma display soft copy devices. There were some video CRT's for signature display, pictures, color. Evans and Sutherland had their precision graphics CRT on the floor. Very impressive (for a price).

miscellaneous observations

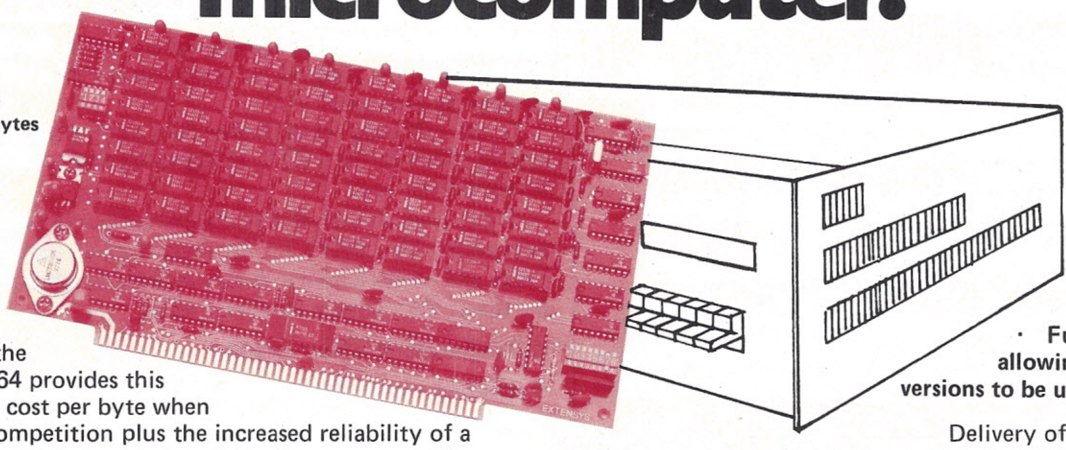
• IBM had a large display near the entrance, with a floor crew carefully balanced on ethnic, sex and age criteria.
• The largest exhibit was by Harris. They are evidently serious about the computer business. • There are still paper tape readers and punches in evidence. • The tape library handler by Cal Comp and the CDC 38500 Mass Storage System were certainly the most fun to watch. • The Data Point Star Trek game was in heavy demand by the Trekkies of all ages. • Capt. Grace Hopper was holding court at the Univac exhibit. • There was an exhibit featuring optical fibers. • Several exhibitors were producing biorhythms for the attendees. • Pertec is getting into the home hobby market via the purchase of Albuquerque's MITS. They had an exhibit upstairs on the main exhibit floor. • Downstairs, there was a personal computer display with a lot of the garage firms in the hobby market – the computers of the future.

extensys corporation

64K for $1495

The most cost effective products for your microcomputer.

RM64
64K bytes



THE EXTENSYS RM64 MEMORY BOARD provides the most cost effective system memory found in the industry. The RM64 provides this because of our low cost per byte when compared to our competition plus the increased reliability of a single board over multiple boards containing less memory. The board is S-100 bus compatible making it usable in over a dozen different microcomputer systems including ALTAIR and IMSAI. The RM64 is available in four configurations: 16K, 32K, 48K, or 64K bytes of memory all on ONE board. The board is completely assembled, checked out and burned in for over 100 hours prior to shipment. This complete testing procedure allows Extensys to provide a one year warranty on parts, labor and materials (assuming no misuse of the board occurs).

On board hardware is provided for:

- **Individual memory bank address selection in 8K byte increments;**
- **Complete dynamic refresh logic without loss of processing efficiency while programs are running;**
- **Board select logic which allows more than one 64K byte board per system;**
- **S-100 bus compatibility including on-board voltage regulator;**
- **Memory overlap which allows memory sharing the same address space to coexist in the same system;**
- **Write protection in 16K blocks; and**
- **Fully socketed for 64K, allowing 16K, 32K, and 48K versions to be upgrade at a later date.**

Delivery of the RM64 is 15 to 30 DAYS upon receipt of order. Prices for the RM64 include shipping and handling prepaid in the continental United States.

Extensys Corporation is also announcing several other new, highly cost effective products. The FOS100 Floppy Disk System is based upon the Extensys File I/O Board and incorporates either one or two dual PerSci Model 277 floppy disk drives. The FOS100 System also includes the Extensys Multiprocessor Operating System, EMOS. EMOS provided many large system capabilities, such as multi-processor, multi-user operation and individual file privacy based on user supplied passwords. The MM16 Memory Manager interfaces to RM64 memory boards to create a megabyte or more of memory and adds full DMA capability to the FOS100 Floppy Disk System.

Extensys Fully Assembled and Tested Prices

RM64-16	$ 595	FOS100-2	$2880
RM64-32	$ 895	FOS100-4	$4680
RM64-48	$1195		
RM64-64	$1495	MM16	$ 295
16K Upgrade	$ 375		

extensys corporation
592 Weddell Drive
Sunnyvale, California 94086
(408) 734-1525

CIRCLE 25

Start your own revolution

with a personal computer

Dramatic developments in computer technology have made it possible for you to *completely reorganize* and *improve* the ways you manage your personal and business life.

Today, for as little as $600, you can buy a complete computer system about the size of a typewriter. These new computers are called *personal* computers. They are every bit as powerful as yesterday's room-sized computers that cost millions of dollars.

A personal computer can be your *equalizer* in dealing with our complicated society. You'll have the same organizing, calculating, and information storage POWER that was previously only in the hands of large institutions. You can have a computer to deal with *their* computers.

As a reader of PERSONAL COMPUTING magazine, you'll be in the heart of the computer revolution. We'll show you how to use your own computer for business and home management—for education, income tax preparation, research, text editing, environmental control, art, games, recipe files, budgeting, inventory control and hundreds of other applications.

PERSONAL COMPUTING is a consumer magazine that makes computers more *understandable* and *useable*. Our readers include businessmen, teachers, accountants, doctors, lawyers, engineers, programmers, and scientists.

Each issue of PERSONAL COMPUTING brings you page-upon-page of useful information and colorful, people oriented articles. Subscribe now so you can be a part of this new revolution.

Please start my subscription to Personal Computing

Name ____________________

Address ____________________

City ____________________ State ____________ Zip ________

USA

☐ 1 year **(12 issues) $14** ☐ 2 years **(24 issues) $26** ☐ 3 years **(36 issues) $38**

Charge my: ☐ Master Charge ☐ Bank Americard

Account # ____________________

Card expiration date ____________________

☐ **Bill me**

☐ **Check enclosed** (you'll receive one extra issue for each year!)
please allow two months for processing.

Additional Postage per year:

Canada & Mexico	$ 4.00 surface
	$ 8.00 air
Other foreign	$ 8.00 surface
	$36.00 air

Please remit in US funds — Thank you

Back Issues $2.00/copy (check with order)

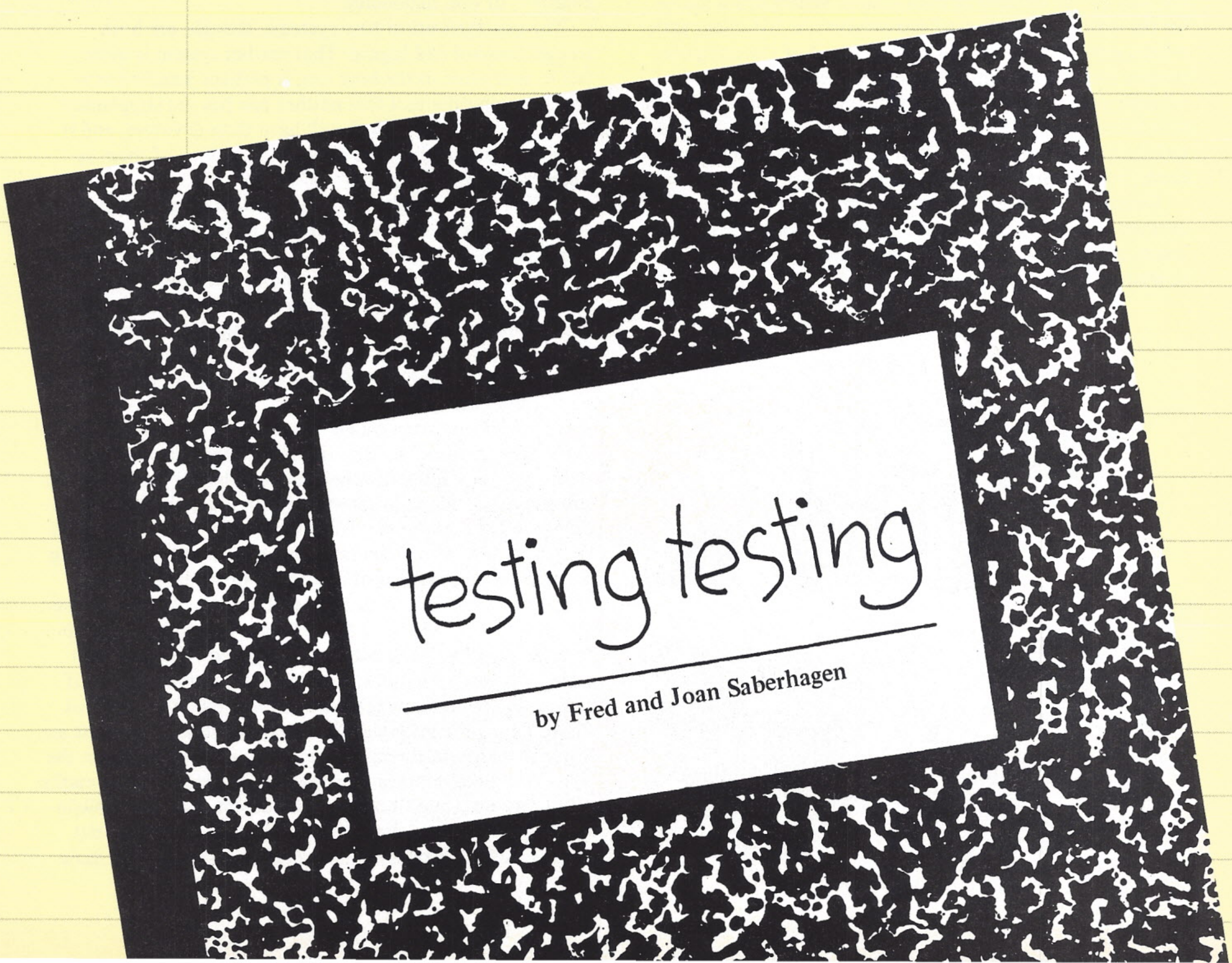
MAIL TO: PERSONAL COMPUTING, 1050 COMMONWEALTH AVE., BOSTON, MA 02215

Now teachers can try new approaches to handling masses of data

An observer from another solar system, scrutinizing the educational systems existing upon our planet, might well report home that the chief product of the many busy minds caught up in them is the *grade,* an abstract entity with something whimsical about it. Related in some way to students' advancement in knowledge, intelligence, and good citizenship, grades represent none of these factors exactly but are certainly easier to verify than any of them. To get out of a school in creditable style (and often merely to get in), good grades are essential, and the better they are the better. The alien's report might conclude with the observation that grades can have a bearing on the gradee's success in getting the job he wants, even long after his formal schooling has been left behind.

Nor is the grader, or teacher, necessarily through with these symbols as soon as they are bestowed and recorded. Given a computer and a few appropriate programs, these products of one grading period can be forged into tools that will be useful to the teacher in the next. Only the arrival of the computer has made a large part of this tool-making process practical. Another innovation, introduced here, is also made feasible only by the computer. It lies in the nature of the grade itself.

A teacher well equipped for home computing might start out to turn old grades into new tools in some such way as this: (1) Assign each student an ID number, to be used along with the student's name in labelling all work submitted. (2) Feed all submitted paperwork through an appropriate peripheral machine, resembling in its function the ones which have been employed for decades in grading millions of multiple-choice tests administered by government and other huge organizations. Such a machine working with the computer will scan each paper, record which answers are right and which are wrong, and the total of each, and assign a grade in percentage form. This percent correct will be immediately marked on the paper, as well as being stored in



the teacher's computer along with the test number, the student's ID number, and the student's answers (where they differed from the right ones).

Having come no further than this, we are already ahead of the game as it is presently played, in that at least every answer on every student's paper will be checked, and every paper graded. (No, they aren't all graded nowadays, teachers' time after school being finite and often spent on something else. It is fairly common, at least at the high school level or lower, for even final exams to remain deliberately ungraded. People do tend to be consistent, and a student who has averaged B all year is not likely to get anything but a B on the final.) But we have only begun to make the computer work for us.

With the grades securely in the computer's memory and ready for manipulation, we can proceed to find averages. Averages are probably not the most helpful figures that the knowledgable teacher with a computer can derive from grades. But they are useful in their way. They have the advantage that administrators and parents, tired from their own day's work can probably grasp what they mean with only a minimum of effort.

Averages come in two basic types, class and individual. An individual average, of course, reflects one student's achievements, starting however far back in the student's career we have the records and the desire to start. A simple average for either an individual or a class is obtained by a program that adds all the grades to be included, then divides the sum by the number of such grades. Averages are useful for the quick comparison of one student, or one class, with others, past, present, or future. The speed of the computer permits such refinements as computing separate grades on separate portions of tests or assignments. This may reveal in time for tomorrow's lesson-planning that the class did quite well on multiplying binomials or assessing Alexander the Great, but poorly on dividing, or identifying religions.

Somewhat more refined programming can obtain not only an average, but a standard deviation, from the test scores of the class. This is, roughly speaking, a measure of how much the scores are spread out. Are most students' marks near the average, or is there a wide variation above it and below? If this last situation exists, a teacher's presentation aimed near the middle will bore some students and befuddle others. The computer can help to determine the nature of the optimum lecture.

Mara Bunnell, age 6

More helpful still should be a count of how many A's there are in the group, how many B+'s, and so on. It now becomes possible using the personal computer to devise an equitable system for deciding how to assign letter grades.

A, B, C, D, F – thus runs the series in most American schools. Some use a variant in which the top grade is S (for superior), and other letters also differ, but the principles (or lack thereof) by which grades are awarded are essentially the same.

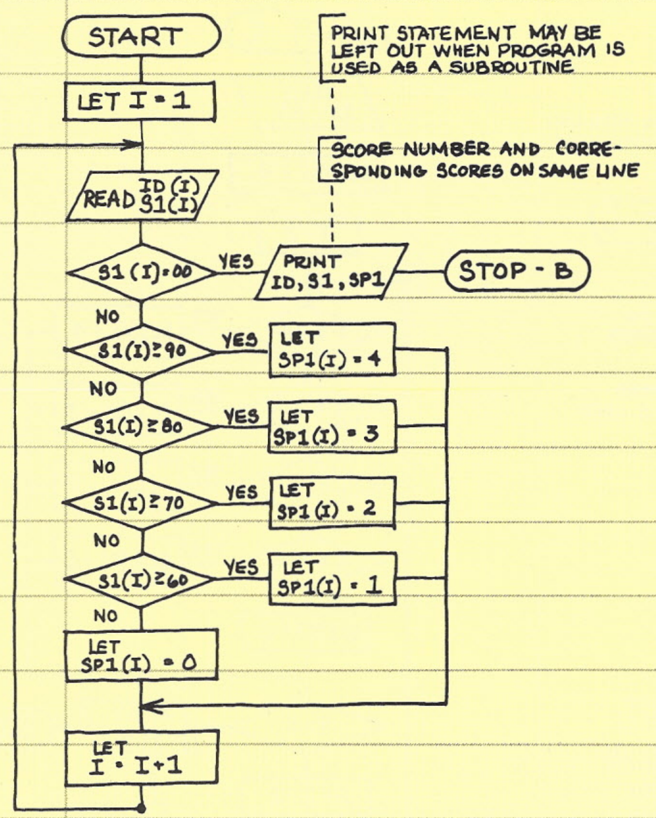
In theory there are presently two systems, and which one any teacher uses as a theoretical base is almost certainly left up to that teacher's personal preference. The qualifier "as a theoretical base" is necessary, because the awarding of grades can still be as much a mode of unfettered self-expression as anything in a class on Modern Dance. True, in many schools the administration imposes some overall standards, on what material is to be covered in class, and what percent of it ought to be learned – also, there may be a standard specifying what percentage of the children must be given failing grades. But in some schools, no mechanism exists for probing, questioning, or justifying a teacher's choice of what grade to give to whom. Intangibles like attitude and effort may be included or omitted. Neatness counts – or not, depending.

The two theoretical base systems, though, are both straightforward and logical. That neither system is quite fair to everyone, in the long run, is perhaps justified as a conclusion by the fact that neither one has yet supplanted the other completely. Both still have their devotees, and it sometimes seems there are as many variations of them as there are teachers.

In what we'll call System One, percentage grades are converted directly to letters. Ninety per cent or above, for example (again, there is no consistent rule) translates into an A, while 80% to 89% earns a B, and so on. This system seems fairly good at showing how much of the material the student has really learned. A disadvantage is that street repairs under the window, a teacher who bungles explanations, or a really difficult course lowers grades just as inexorably as do the students' own shortcomings.

System Two, often called "marking on the curve," dispenses the members of the class along the chart of what is known as normal distribution, the bell-shaped curve familiar to students of statistics. Stone steps in old cathedrals, worn down by the random feet of centuries of visitors, can graph this curve. So can innumerable other phenomena, including the test-passing abilities of any group of students. So in a class of twenty, say, using System Two, the two top achievers are awarded A's, *regardless of what percentage of problems or questions they correctly answered.* The four next highest finishers, perhaps, get B's. Down at the bottom of the scale, the unhappy lowest two *must* fail. The four just above failure are awarded D's – and the bulk of the class are left colorlessly in the middle with their C's. Marking on the curve has the advantage that the best students get top marks, no matter how mind-boggling the subject matter or how inept its presentation. A woeful drawback is that a student getting 90% of everything right could, in theory, still draw

PROGRAM FOR CHANGING % GRADES TO 4,3,2,1,0 GRADES



PRINT OUT FOR CHANGING % GRADES TO 4,3,2,1,0 GRADES

ID	SCORE	SCORE - %
237	66	1
564	75	2
321	81	3
176	88	3
521	96	4
135	97	4
478	87	3
137	77	2
521	71	2
576	79	2

an F and fail, if everyone else in his class has done still better than he. And conversely, achievement of an A is no warranty at all that very much of the subject matter has been understood – only that almost everyone else in the class was worse off than the A-achiever.

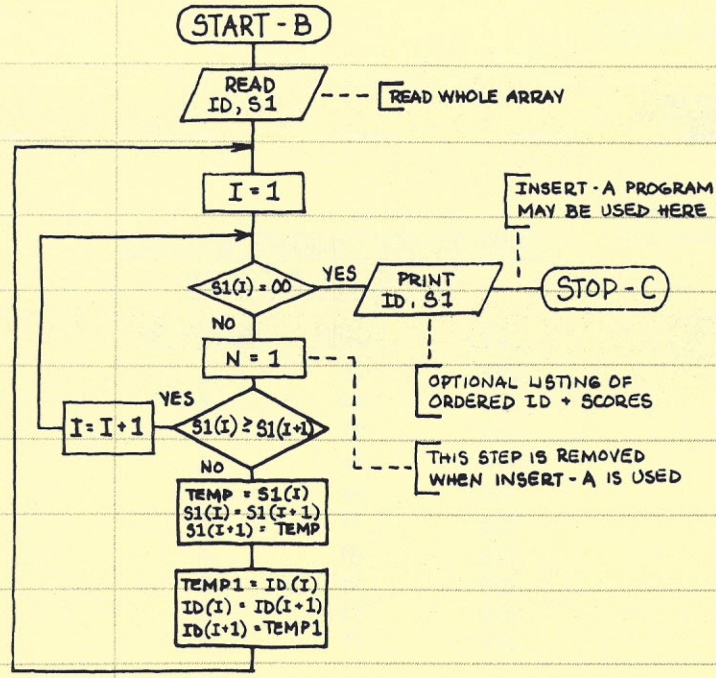
It is understandable, with both systems threatening such inequities, that teachers avoid using either in a pure form. Besides the administrative restrictions that may be imposed, each teacher tends to establish a personal set of modifying rules, such as: "I'll never give anyone an A for less than 90%" or "I can't pass anyone with less than 65." It is common to give a break by dropping a student's worst test grade from the figures before a final average is calculated from them. (The figures averaged to make a final probably include a number of test grades, and several grades on homework or classroom performance.) It is also common to control results by making tests harder or easier, or by "teaching for the test."

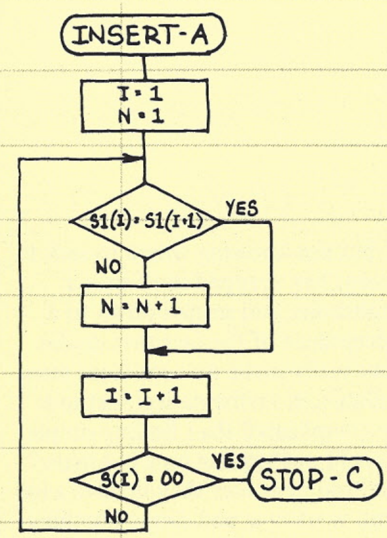
Long in need of relief, but not knowing where to seek it, the educational establishment has wrapped itself into a patchwork quilt of such solutions, and settled down to a numbly uncomfortable acceptance of the fact that grades as they are now handed out really make no consistent sense. One source of relief is available, in mathematical methods that are only a little more complicated than finding simple averages. These methods could put grading on a consistent and equitable footing. The trouble is that they involve a lot more time-eating work, dull work eye- and finger-numbing in its tedium, than any conscientious teacher (already dragging home papers by the bagful) cares to contemplate.

Comes now the personal computer, with its speed and its electronic appetite for tediousness, to put these methods within practical reach. One good approach would seem to be to grade each test or assignment, on the computer, by both present systems. Then the two results can be mathematically combined. One or the other may be "weighted,"

The products of one grading period can be forged into tools that will be usefull to the teacher in the next.

PROGRAM FOR ORDERING SCORES



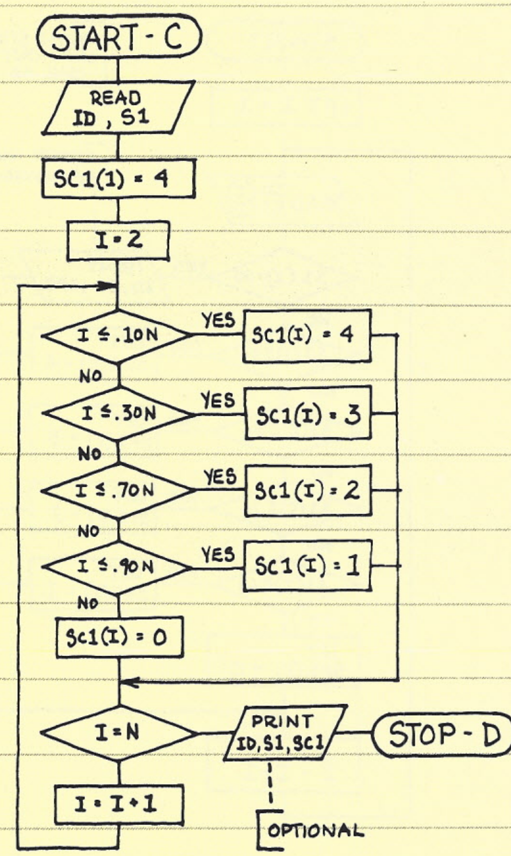


PRINTOUT

ID	SCORE
135	97
521	96
876	88
478	87
321	81
576	79
137	77
564	75
521	71
237	66

PROGRAM FOR CHANGING SCORE

TO 4,3,2,1,0 BASED ON CLASS CURVE



PRINTOUT

ID	SCORE	SCORE-CURVE
135	97	4
521	96	3
876	88	3
478	87	2
321	81	2
576	79	2
137	77	2
564	75	1
521	71	1
237	66	0

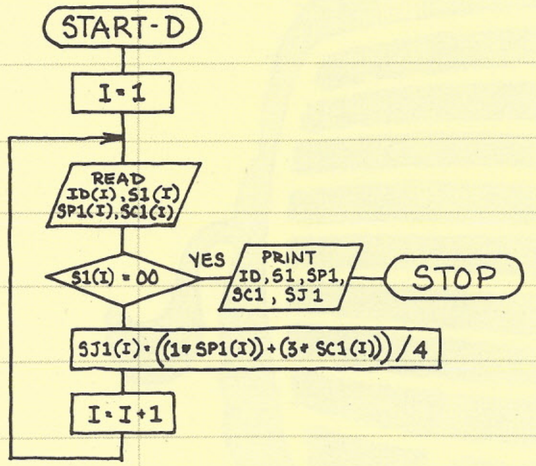
increasing its influence on the composite result, according to some standard to be imposed, worked out, or adopted as the teacher's choice. It should be rather easy to find formulas which assure that no one getting only half the questions right can earn an A; that no bright kid will be stuck with a C on his record simply because he found himself in a class with six or seven who were brighter still; and that all the strugglers in between can feel their mediocre grades have an objective and justifiable basis. For example: If percent and curve scores are equally weighted to form the composite grade, the most extreme case of the same score earning an A in one system and an F in the other produces a tolerable C. And not least of the advantages may be the fact that the teacher using this year's grades (or last year's, perhaps from a different school) as computer fodder for planning future work, will be able to feel somewhat more confidence in what those grades represent.

Attitude, effort, and the other intangibles can still be figured in – or not. But if included, they will appear visibly, objectively, in the form of numbers on a scale. Neatness or any other variable can have its own scale if it is thought important. At first, it might seem that the time gained by grading with the computer is now to be lost again in punching in these extras. But time is already being spent on them, if they are considered in the grading process; perhaps more time than will be necessary when a computer is used. Furthermore, time is well invested putting relevant information into the computer system, in terms of storing up material for future use.

Let's try out the composite grading system, taking as a first example a student who finishes second highest in a class of twenty, with a percentage mark of 85. This would probably rate a B or C in System One, and an A in System Two. To calculate a composite grade from these, let's represent A by 4, B by 3, and C by 2. For the student in question these numbers average out to 3 or 3.5, a composite B or perhaps B+. (Present practice generally forbids "minus" or "plus" refinements on final, official grades, though these

PROGRAM FOR CALCULATING JOINT SCORES

(BOTH % AND CURVE)



PRINTOUT FOR CALCULATING JOINT SCORES

ID	SCORE 1	SCORE PERCENT 1	SCORE CURVE 1	SCORE JOINT 1
135	97	4	4	4.00
521	96	4	3	3.25
876	88	3	3	3.00
478	87	3	2	2.25
321	81	3	2	2.25
576	79	2	2	2.00
137	77	2	2	2.00
564	75	2	1	1.25
521	71	2	1	1.25
237	66	1	0	0.25

A COMMENT TO THE PROGRAMMER

The programs given change percentage grades to equivalent letter grades.

A trailer card 00 signifies the end of the data. The data input is the student identification and the percent score. The test must be designed so each person taking it earns at least one point.

The counting of scores is initialized at 1; the letter I is used for counting scores. The ID's and scores form a simple array.

The letters SP indicate scores-percentage grade.
SC indicate scores-curve grade
SJ indicate scores-joint grade
ID indicate student identification number
S indicates the original score

The programs should be set up so they can be used either independently or as subprograms.

The programs-subprograms are:

1. Changing % (S) to A,B,C,D,F grade based on % goes from first START to STOP-B. Ninety per cent or more is considered an A, 80's — B's, 70's — C's, 60's — D's, 59 and lower F's. An A is designated by 4, a B by 3, C by 2, D by 1, and F by 0.

2. Changing % (S) to A,B,C,D,F, grade based on curve; in the first section scores are put in descending order. This goes from START-B to STOP-C. The program counts N, the total number of scores, within the body of the program. If the programmer wishes to count only distinct N's (the number of different scores) and base the curve on this figure, the N step must be removed and the INSERT-A program used before STOP-C.

3. Assigns 4,3,2,1,0 grade on basis of curve designed by programmer. Curve used here has upper 10% as A's next 20% as B's next 40% as C's next 20% as D's bottom 10% as F's

This program assumes at least 10 scores.

4. Joint Scores calculated. Main program that uses results from other programs by one of two methods.

(a) Calling up other programs as subprograms.

(b) Linking all previous programs to Joint Program. All intermediate STOP commands would be removed, repeated READ commands would be removed.

symbols are seen commonly enough on returned papers and in teachers' day-to-day records.)

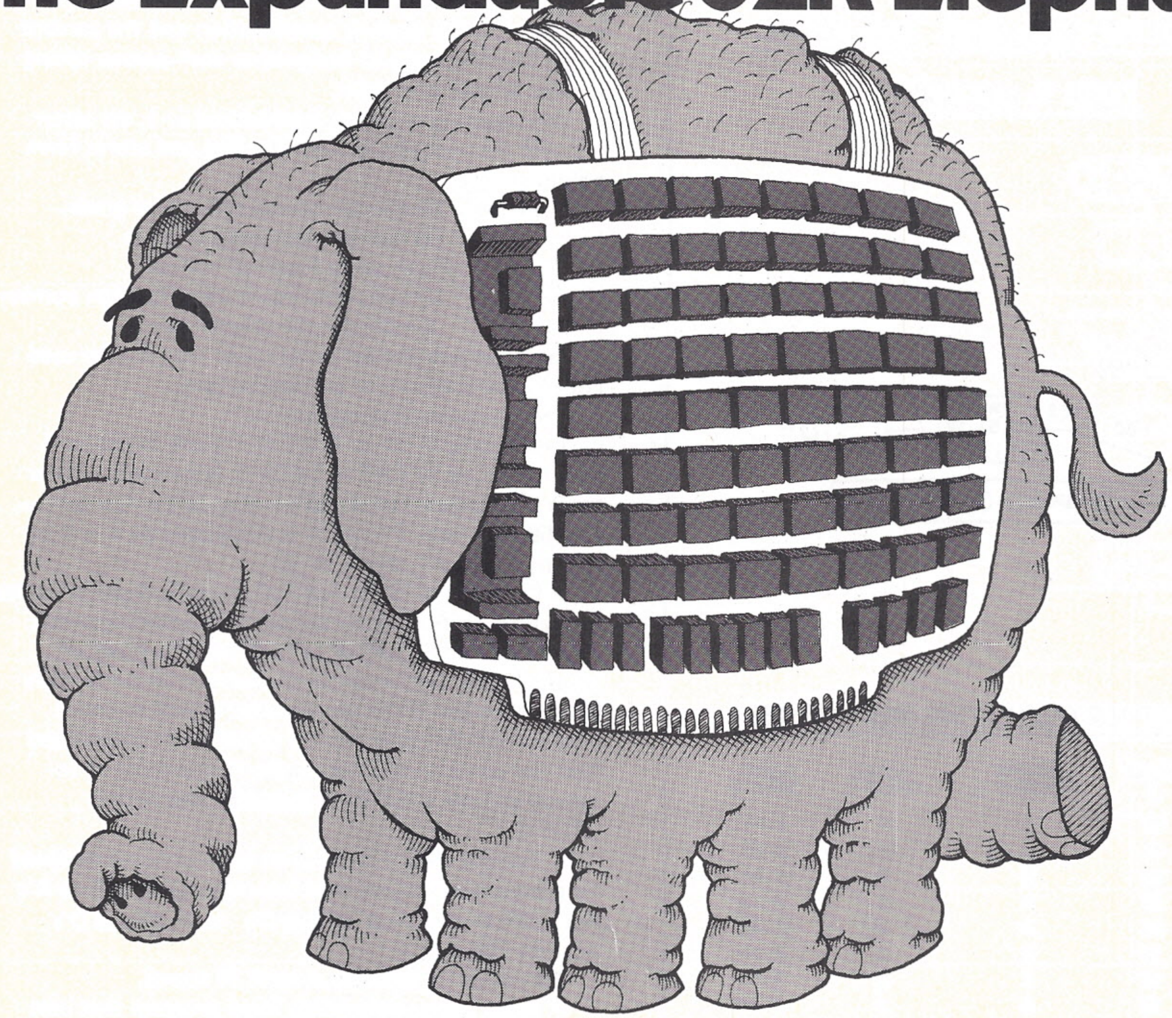
So, our first example would notice no more than a moderate change in his grade if his teacher switched suddenly to the new composite method. How about a more extreme case, Example Two? This fellow got only 65% correct, but was still the best scholar in his night-school class of knot-tying for neurosurgeons. His top class rank earns him an A in System Two, his 65% at best a D in System One. The new system awards him a low C.

For our third example we have a student who stands only seventh in his class of twenty clever people, but did score 90%. An A or at worst a high B in System One, a flat C in System Two. In the new composite, high C or plain B.

Whenever the teacher setting up a composite system for grading finds an example with which he or she is displeased, a little mathematical weighting or tinkering will produce a more satisfactory result in the troublesome case, without altering overall results by much. Consider the intangibles mentioned above, attitude, effort, and the like. Consider grading them, as objectively as possible, along with the homework, over the course of the school term, the final "intangibles" grade to become part of the overall average at the end. Consider further instructing the computer to weight the grade of attitude and effort to have more effect, the lower the average of the strictly scholastic grades for the individual student. Now the kid who breezes through with an easy A will not be hurt by his bored attitude, for which it is really hard to blame him; while another student who struggles fiercely to learn and falls just short of passing will be dragged to safety by his determination.

It is patently foolish to expect any single philosophy of grading, or any single program for determining grades to fit all schools and all subjects at all age levels. A pat on the back that encourages the sixth-grader is misplaced between the shoulder blades of the would-be surgeon or airline pilot aged twenty. But the conscious, fully thought out design or selection of standards appropriate to each is now at hand.

ARTEC Introduces
The Expandable 32K Elephant

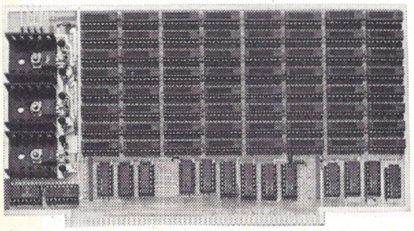


The 8K-32K Expandable Memory That Grows With Your System

Now, for the first time, you can have a reliable true static memory that will grow with your system. Start with the board and 8K memory. Then add on one, two or three 8K increments of memory up to 32K. 250 ns access time. The Artec 32K Expandable Memory allows you plenty of room for memory and all necessary support hardware.

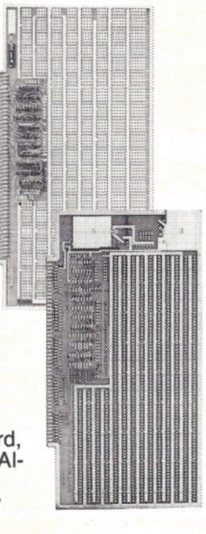
For five years Artec craftsmanship and reliability has been proven in tough industrial use. Now, you too can enjoy breadboards and memories that will work time after time. Boards like the GP 100 and the wire wrap WW-100. Send for an Artec Board, your order will be sent the same day as received.

Board & 8K of memory—$290.00
8K add on kits—$255.00 ea.
Full 32K board—$1,055.00



GP-100—$20.00
Maximum design versatility along with standard address decoding and buffering for S—100 systems. Room for 32 uncommitted 16 pin IC's, 5 bus buffer & decoding chips, 1 DIP address select switch, a 5 volt regulator and more. High quality FR4 epoxy. All holes plated through. Reflowed solder circuitry.

WW-100—$20.00
A wire wrap breadboard, similar to the GP 100. Allows wirewrap of all sizes of sockets in any combination. An extra regulator position for multiple voltage applications. Contact finger pads arranged for easy pin insertion.



TO ORDER: Use your Mastercharge or BankAmericard. Or just send along a money order. Your order will get same day service.

FOR MORE INFORMATION: For more information about these or any of Artec's complete line of circuit boards or for either industrial or personal use, please call or write. A catalogue will gladly be sent.

Please send me:
☐ 32K ☐ GP-100 ☐ WW-100
☐ I've enclosed a money order.
Bill my ☐ Mastercharge
☐ BankAmericard No. ________
Name ________
Address ________
City ________ State ________ Zip ________

10% discount for students & computer club members.

ARTEC ELECTRONICS, INC.

605 Old County Rd. • San Carlos, CA 94070 • (415) 592-2740

See the Elephant at the Mini-Micro Show (Booth #110) and the Personal Computing Show (Booth #29)

CIRCLE 42

ED ROBERTS TALKS ABOUT STARTING AN INDUSTRY

An era has ended.
H. Edward Roberts, the entrepreneurial engineer who carried a desperate little company to success by introducing the first real "personal" computer to a popular market, has survived the harrowing startup, sold the company to a bigger firm, and has resigned from the enterprise, announcing his intention to go back to Georgia to be a farmer.
He leaves in his wake a long line of people who are still hoarse from screaming matches with him, enemies, admirers, friends, and amazed bystanders who are fascinated by the phenomenon of personal computing that Roberts has precipitated largely by the force of his will.
Roberts is outspoken, opinionated, often irritating, but always interesting. His comments as he departs MITS are certain to stir controversy, but they provide an invaluable perspective on the first boom in personal computing.
These interviews were conducted in Albuquerque by David Bunnell, publisher of PERSONAL COMPUTING, who was Vice-President of Marketing and Advertising Manager for MITS before leaving the company to found this magazine. While this creates a certain amount of "insider" talk between two associates recalling old times, even newcomers to this field will find insights in this discussion of the rough-and-tumble beginnings of a new industry.

Personal Computing: Begin with the history of Mits, the company that started the personal computing market. When was Mits formed?
Ed Roberts: We formed Mits as a partnership in August of 1969, and incorporated in the spring of 1970. Our first product line was micro-telemetry equipment, primarily for the serious model rocketeer. That's where the name Micro Instrumentation Telemetry Systems, or Mits, came from.

How much capital did you have?

At the outset I had about $10,000 worth of equipment and parts I'd accumulated with various consulting businesses over the previous five or six years. There were four partners and I believe we put up $400 each. That was the extent of our initial cash outlay.

You really didn't develop many telemetry systems. What was your first real product?

Our first real product was one that appeared in Popular Electronics called the Opticon. It was a voice communication device with a range of about 500 feet. We sold a couple hundred of them which turned out to be a kind of financial fiasco. As a matter of fact,

that product was the reason I ended up buying out the other partners.

Your first products were kits?

Actually, the few telemetry systems we sold were about half kit and half assembled. This was very important to us later because we had to learn the techniques for writing assembly manuals. That was probably the biggest contribution these early products made to Mits. Plus it gave us a little bit of exposure. We did some advertising in a magazine called Model Rocketry, which is long since defunct.

I remember seeing that ad.

Yea, those were class ads, there's no question about it. (laughter)

What was your first calculator product?

Well, in 1969 we built telemetry systems because Forest Mims, one of our partners who today is very well known in electronic publishing circles, knew that there was a market. There were some easy products to develop in that field but since 1959 I had been developing computers of various kinds, starting with a quasi-relay computer, so that had been a lifelong ambition. Our first calculator was the 8-16, which was programmable and used the six chip LSI array from Electronic Arrays. It was on the cover of the October, 1971, issue of Popular Electronics, and the programmer was introduced a year later. To the best of my knowledge it was the first low cost programmable calculator system that money could buy. We were also the first American company to build a kit calculator, the first to build LSI calculators. At that time a typical programmable calculator such as the HP9100 sold for $6,000 or more.

> **"Having a large number of people involved in computers will make an enormous difference in the speed of the technology."**

What did the 8-16 sell for?

It was introduced at $199 and our bill of materials was $167.

Could you back up a moment, and tell us what a "quasi-relay computer" is?

The relay wasn't quasi, but the computer was. It was quasi-programmable in the sense that you could change wires around and make it do different things. But all the logic was relay logic, electro-mechanical stepping motors and that sort of thing. You know, 15 years later that seems primitive, but at the time it was state-of-the-art technology, which is pretty interesting.

What was this quasi-relay computer used for?

The original relay computers that I was fooling around with were controllers for robots. At that time there were a lot of turret drivers for machine guns off of airplanes that were easily attainable. They were 24 volt motors that were geared down and I was using relays to control those motors.

Mits reached a peak during the calculator business and then nearly went bankrupt. Do you recall the peak of that cycle?

Our original calculators included the 8-16, 8-16A, 8-16B, 1440, 7400, and the 7440. These were all programmable and were designed for the real enthusiasts, but since we were in the calculator game early we thought we were in a good position to produce calculators in volume. We got side-tracked and went into the handheld calculator business. We did this for about two years and in our top form we were shipping about 5,000 machines a month, which by today's standards isn't very much but was a lot of volume then.

Do you feel you got suckered into that market?

We were suckered in by ourselves, not by anyone else. It looked like a golden goose, so we got away from what we intended to do, which was build computers. This was true throughout the history of Mits, that is the worst things that happened were things we did to ourselves.

Do you draw parallels between that and the current situation in the microcomputer business?

I think we are going to see a bottom-end group of machines that are somewhat similar to what occurred in the calculator market. You won't see an exact parallel, mainly because of the nature of peripherals you need to make a computer system a usable system. We're already seeing some of this and I think these machines will be sold to a different group of people than the machines that are in the hobby now.

The typical Mits customer is interested in building up a real computer system. Most of the products I see in the real low cost area are, "what you see is what you get." They do some lip service to having add-ons and allowing for floppy disks and line printers, but they aren't seriously committed to the system approach. The nature of these companies is that they are high-volume oriented, which means you don't build 50 or so machines, you build thousands, and that doesn't allow for much customization. You have to keep the price low to obtain the quantities you need and that puts you in a special case market.

The PET and the Radio Shack computers are probably examples of this. The market they will address is primarily bottom-end, high volume. That's a different kind of market than what most companies that are in the business now are getting into. I have no doubt that some of these companies will get suckered into that bottom-end market, because the volumes will be very exciting.

Don't you think Commodore and Radio Shack will hurt some companies in the market today even though they may be producing a different type of computer?

I think they will hurt a number of companies in the market right now that build limited products without much support. The PET computer will be cheaper even if it is not as good in quality. However, the system people including companies like Mits, Processor Tech, Imsai and Digital Group, and I may be leaving some out, will be hurt less. People like Ohio Scientific, and a bunch of folks like that, will probably be hurt.

Getting back to the high volume calculator business, what was the single most important factor in ruining that for Mits?

The thing that ruined that for everyone was a characteristic of the electronic companies to become prostitutes.

How do you mean?

It turns out to be a big price war and the net effect is that nobody makes any money. To still have a viable company after having been in the calculator business was success. If you could just live through it,you were successful.

I remember going through a period of a couple years where I'd lay awake at night wondering, "are we really that stupid". . . we'd look at the machines, at our material cost, at our labor costs and find out a particular machine cost us $40 to build and someone else was selling it for $39. There were dozens of companies that got caught in the syndrome that if the guy down the street could sell a calculator for $39 they must be able to sell one for $39. It was interesting that the big companies like Texas Instruments and National Semiconductor got caught in that sort of thing too. The philosophy was that if you were losing a dollar a machine you could make it up in volume. It just wasn't true.

Do you recall how many people Mits employed at the peak of the calculator business?

Close to 100.

You found you couldn't be competitive in the calculator business without selling products below your own cost. So you decided to pull out of the market?

It was pretty clear we couldn't compete in that market and by 1975 we reached a point where the intent was just to clear the inventory. In mid '73 I started to reevaluate the situation. We began to look at other things and to the best of my knowledge we were the first company to build an LSI digital clock. But by that time I was a little bit smarter about getting sucked up into the consumer thing. We were getting lots of opportunities to build digital watches and we passed on all of them. I think history says that was a good decision. So, I began to realize that what we brought to the game was fairly high technology products in fairly low volume. We were not a high volume production company.

We got re-oriented to the computer business. It was kind of a comeback to where we had started. We then went through an exercise checking out the various microprocessor chips including the 4004, 8008 and the 6800. We decided to go with the Intel 8080 which at the time was just being sampled and wasn't really a production product. We started full development work on the 8080 in the spring of '74 and our first prototype was ready in August of '74.

About this time you were faced with laying off employees and worrying about finances and that the company got pretty small.

Yes, we got down to 24 people. Actually we didn't have to lay off many people, we just let attrition take care of it.

Then there were times when you thought you wouldn't make it over the hump, that you'd go bankrupt.

One of the things an entrepreneur has to do is accept reality when things are pretty grim. I felt that we were flipping a coin and if the odds were working for us we would pull out of it but I accepted during 1974 that the odds were better than 10 to 1 that we wouldn't pull out of it. We went through an enormous number of gyrations during the design of the Altair trying to come up with sources of capital. We talked to all sorts of venture capital people with all sorts of hokey deals when we knew that we were going to get raped, but that might at least save things. The net effect, interestingly enough, was the people we ended up using was the bank. Those guys bailed us out. It's the least likely place to get help in that kind of situation, but we had good bankers who believed in what we were doing. And essentially the same thing with Popular Electronics. We were lucky to have a banker and a magazine who believed there was a real market.

You had a publisher who was willing to take a chance, so in October of '74 you went to New York with the Altair and showed it to the editors of Popular Electronics.

Funny story about that. Things were super grand then. We were betting our whole lives by that time on the Altair computer and you never like to bet on just one product. I was convinced that it would do well, but what I defined as well turned out to be pessimistic, even though at the time people thought I was a wild-eyed optimist. But we shipped the Altair and registered it and insured it for $2000 or something like that a week or 10 days before I was supposed to go to New York. A week went by and it hadn't showed up, so I went there anyway thinking it had to be there by the time I was. Well, I think the thing showed up a month or two after the article was published. That put me in the position of trying to explain to the editors how the Altair would look if they could actually see it. All I had was a handful of schematics. Les Solomon and Art

"(The 'S-100 bus controversy) strikes me a little bit like somebody calling the Mona Lisa 'Sally' because they like the name better."

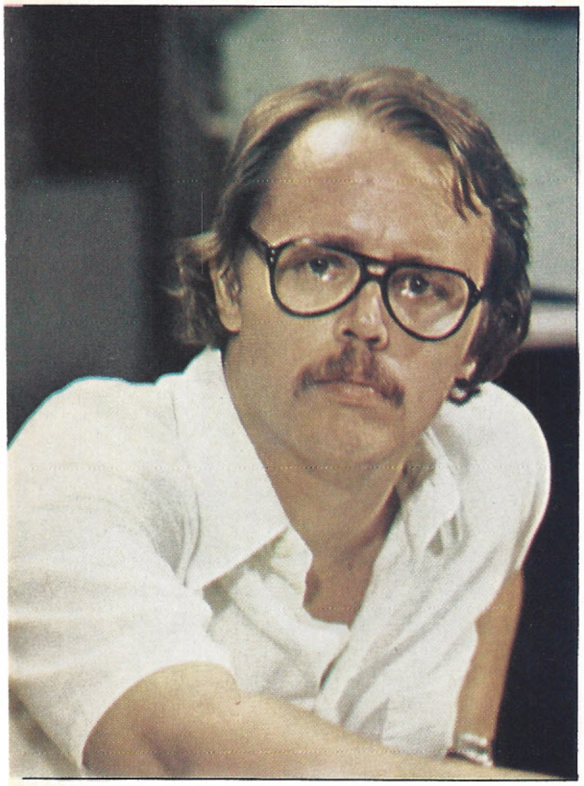
Salsberg (editors at PE) were taking a lot of gas and we were putting them in a mode where they had to commit to publish it based on our word. And they made this commitment even though we got a working machine to them a couple weeks later.

Wasn't the machine you lost the only prototype?

Yes, it was. So while I was in New York, Bill Yates, the project engineer on the Altair, started another one. They made the commitment based on the fact we had always done what we said we would do in the articles they published before.

How does a small electronics firm in a place like Albuquerque develop such a good relationship with a national magazine like PE?

The initial relationship was developed by Forest Mims, who was writing



"What do you see as the single most important factor in ruining the calculator business for Mits?"

articles and doing a good job for them. Probably one of the reasons PE, and this goes for Radio Electronics as well, have been successful is that they have always been looking for revolutionary new things in electronics. They've taken some chances and been the only ones to survive the hobby electronics crunch. They made some good decisions and we built up a good reputation with them, but it certainly wasn't a safe way to operate.

When did you first meet Les Solomon?*

In 1970 or 71. He was on vacation and came by just to meet us.

I take it that both Popular Electronics and Mits benefitted from the 8-16 calculator cover and that led to other things.

Sure, it certainly wasn't a one-sided affair. No question from our standpoint that they were key to our success.

Do you want to tell the story about naming the Altair?

Apparently Les mentioned to his daughter that he was looking for a name for a computer. She was watching Star Trek one night and they were going to the star Altair and she thought that might be a good name. The only place I had ever run into Altair before was in *Forbidden Planet,* which was one of the real classic science fiction books that came out in the mid-50's. The planet is one orbiting Altair – Altair Four or something like that.

It's interesting because I can't get too excited about names or cosmetics or that kind of stuff. Whatever made PE happy was fine with me, but as it turned out the Altair name was very important to the product.

Les was pretty big on names and I'm sure he's the one who insisted we do this. At the time you were running our advertising agency and you had everybody in the company looking for names.

Yes, we had three pages of suggested names and they were all terrible. 'Little Brother' was one of my favorites. It probably would have destroyed the product.

So the article came out and it's history now that Mits was flooded with orders. Where did most of these orders come from?

You've got to back up and realize that no matter what product you deal with your first order surge always comes from hobbyists. If you have any company or OEM interest it takes a couple months to process a purchase order or convince somebody that they need to process a P.O. But the term 'hobbyist' in this market is a misnomer. These hobbyists had an entrepreneurial interest. I'd say less than 20% were pure hobbyists. Even in a hobby like photography you get a significant percentage of people who are into it with the intent that they have to make some money.

In a recent Business Week article you compared the beginning of the personal computer business with the time George Eastman opened up a mass market for photography with the box camera. Is this really a valid comparison?

Well, I think the analogy is interesting in the sense that people have been taking photographs since the early part of the 19th century, but it didn't get popular until 1889. That was the real key. Matter of fact, people were taking color photographs well before Eastman and some of it is still around and still very impressive. You can compare this with computers to some extent, even though the time span is different, in that they have been around for some time but very restricted as to who used one. Everybody talks about it like 1950 was when people started doing work with computers but actually there was some work being done in the 30's and certainly some very serious work being done in the 40's. Eastman wasn't the first guy to do anything with photography by a long way but it's pretty clear that if you had to pick a name in photography it's Eastman. It wasn't until the Eastman box camera–and I think the thing had 100 or 150 shots in it and you sent the whole box back to the company for processing–that the field really opened up to amateurs. What is interesting is what can happen to computers once a significant percentage of the population has access to them. Having a large number of people involved in computers will make an enormous difference in the speed of the technology. Beyond that you have to be careful about the analogy between computers and photography because you're talking about a different kind of thing.

Weren't the early Mits customers mainly technical people already involved with computers or similar technology?

Out of the first 1000 customers, if you were to do a survey, you'd find 900 or more were actively in the electronics industry. Some of them had never worked on computers before, but they had a fairly sophisticated background compared to someone who walked in off the street. It's still true that the typical Mits customer is a reasonably knowledgeable person in electronics or computer programming.

Beyond the hobbyists, who were the next group of people to buy Altairs?

The second largest market we've

**Les Solomon, who is the technical editor of PE, was instrumental in bringing a number of computer products to the forefront of the electronic hobby business. The Sol computer from Processor Technology is named for him.*

always seen has been the accounting kind of market. I use "accounting" in a generic sense, you know, people who want to do inventory, special kind of controls and that sort of thing. And a lot of that was being done by the entrepreneur hobbyist.

What about some of the design concepts behind the Altair. I'm particularly interested in the open-ended bus structure. Are you happy that you went that way?

I think it represented a more optimistic view of the market than we should have had. But the intent was to build a real general-purpose machine that was expandable forever. If I had to do the bus today, I'd do it quite a bit differently than I did with the original Altair,for a number of reasons. In terms of the bus structure itself, I think that was one of the decisions we made that was right. Ninety percent of the people who have been successful in this industry have sold products to support the Altair bus, which brings me to one of those things, and I don't think I ever said this publicly, but one thing that irritates me about calling the Altair bus the "S-100 bus" is that it's a point of honor more than anything else. It strikes me a little bit like somebody calling the Mona Lisa "Sally" because they like that name better. I don't mean to equate the Altair bus to the Mona Lisa in terms of creativity and the quality or anything else. As a designer of the Altair bus it's a point of honor and maybe an ego trip, but that really irritates me.

One of the drawbacks of the Altair bus was that it opened the door for a lot of competition in memory and interface boards. Wasn't one of the original ideas that you could sell the bus or mainframe at a low cost and make up for it with better margins on memory and I/O boards?

That's always true in the computer industry. Even without the open bus structure you could add cards through cabling or something. We had some real heartaches over the bus as to whether it was worth putting money into supporting it, as opposed to saying, "OK, you can have an Altair and we're going to allow you to add up to 8K of memory and three I/O ports." If we went that way I think the industry would be entirely different today. A lot of the success with the Altair wouldn't have occurred, but it certainly increased the cost of the system to go with that kind of bus structure.

Looking back, wouldn't you say some of the early competition was helpful in that it gave needed support to the bus structure?

That was particularly true of Processor Technology. They have a lot of resentment for us because we are the IBM of the industry, but they have contributed some products that are pretty interesting. They were the first company that amounts to anything to support the bus besides Mits. There were some other people about the same time that were announcing cards but Processor Tech, you would have to say, is number two. And they certainly made some contributions to the overall system development.

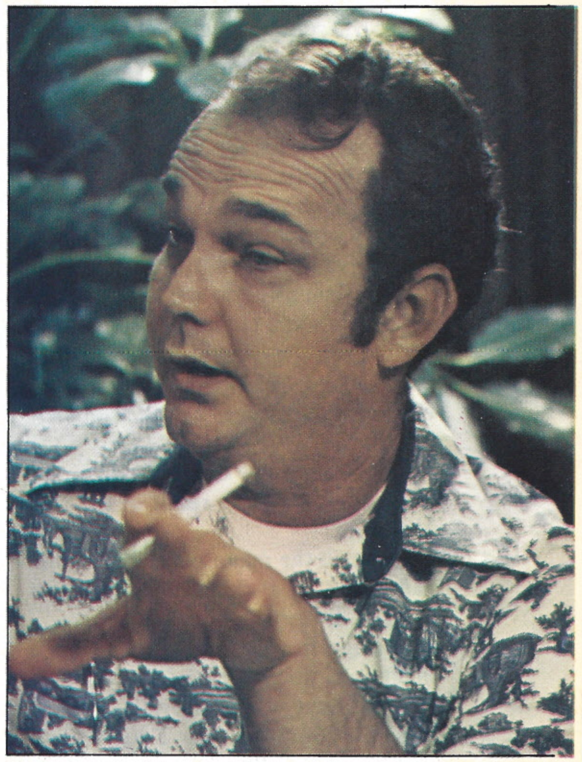
What were some of the problems you ran into that you may not have anticipated?

The biggest one was volume. In the proposal we made to the bank we predicted we'd sell 800 machines in 1975. These machines would go to the quasi-hobby market which would pay for the development cost and allow us to explore the special purpose markets. The second month after we started production, which was March 1975, we shipped 1500 mainframes.

The second problem from my standpoint was trying to get people like Intel to take us seriously. We were the largest user in the world of the 8080 and they still didn't believe there were many people out there that wanted to build computers. We were selling the Altair for $398 and the 8080 chip in single quantities was selling for $360. Intel got a lot of pressure from their distributors. A guy could buy a machine from us and even throw away most everything and still have a case, transformers, switches and the 8080 chip. It was pretty clear that it was a super deal, and it was because our bill of material cost was $320.

Our purchase order with Intel was always for full performance, full spec parts, but they came out with the "-8" bar on the chips they were shipping to us and we took a lot of gas for a while. They were trying to appease their dealers by saying we were selling chips with low temperature specs, which we never agreed to. They were saying that the reason our price was so low was because we were using fallout parts, which was never true.

The problems with Intel and with volume delayed some of your other development plans and you weren't able to support the bus as fast as you would have liked to support it.



"The thing that ruined that for everyone was that electronic companies tend to become prostitutes."

Processor Technology, Imsai and a number of other companies wouldn't exist today if we could have expanded our production fast enough to meet the demand. People were forced to go to other sources.

The original Altair was marketed strictly as a mail order item. I know you felt a need to get the machine out into the public and let people see it. What was the solution to that problem?

The first thing we did was set up reps, which was not very successful.

What went wrong there?

The major problem was that the

product was too complex. I don't think any computer manufacturer has had much success with reps. I suppose that everybody who has built a computer has gone through a similar learning exercise. They go out and set up reps and end up doing their own sales.

Other than reps, I think the biggest thing we did was set up the traveling van – the Mitsmobile which went on tour throughout the country demonstrating working machines. That did a lot to give us credibility.

The final solution was, of course, setting up retail computer stores. We started this program in the spring of '75 and Dick Heiser had the first store opened in Los Angeles in the summer of '75.

Didn't many of the original computer clubs start as a result of the Mitsmobile?

Most all the major computer clubs had their start as the result of the Mits caravan. Everywhere we went there were large crowds and it got to be a practice at the end of the show for us to ask if anyone was interested in setting up a computer club. I don't think they'd like to admit it, but the SCCS got started that way.

After having overcome many of the problems associated with failure in the calculator market, you had to face a whole new set of problems associated with success in the computer market. How were you able to cope with this?

At the time we started making the Altair the whole management staff including the CEO lacked the maturity needed to support this new market. But we had some pretty good people like yourself, Pat Godding, Bill Yates and others. I think in retrospect there were people disagreeing with decisions I made, but everybody was pretty excited with what we were doing. I know that during early 1975 we went through a period of morale problems in the sense that we were having internal conflicts. But the problem was that everybody was dead set on getting his job done and if anybody got in the way he was going to get run over. If you're going to have morale problems, those are the kind to have, as opposed to the ones where no one is willing to make a decision. An important part of the success of Mits was the fact that we had some gung-ho people who were excited about the market. I don't think they were excited by Mits that much, but they were excited about what we were doing in the market and they accepted the fact that it was pretty important. That was even true on the production line. We were establishing a whole new market and everybody knew that. We were pushing back some frontiers.

Managing a group of people like that is an interesting exercise, because you need a lot of free spirits,and free spirits are hard to establish in any kind of coordinated effort. The fact is we never did establish much coordination, but I think the lack of being regimented was a real advantage. We got a lot of things done.

You had people doing things that they thought were right and taking a lot of chances, I know I did.

Well, particularly in your case! We had some people who were to some extent yoyo's but they were given freedom and actually it's a funny thing about people anyway, that they'll respond at whatever level they have to.

Your problems with success also led to customer relations problems with people who weren't getting support as fast as they would like.

As fast as they should.

Yes, and people weren't satisfied with the repair they were getting because your repair department was clogged up. I think it was because of these problems you decided to have the first hobby computer convention, the World Altair Computer Convention.

Well, I don't know, that convention was the responsibility of one guy, as we both know. It was certainly a public relations attempt.

Computer Notes (the Mits company publication) was the first real published book that was out. It preceded Byte, didn't it?

Yes.

If you look at the things we did, The World Altair Computer Convention, Computer Notes, the Mitsmobile, the retail stores, we did a lot of pioneering that's been lost in the shuffle. Much of what the industry is like today was done first by us.

Part Two of this exclusive interview with Ed Roberts will be carried in the January issue of PERSONAL COMPUTING. Among other things, Roberts will discuss the acquisition of Mits by Pertec Computer Corporation, the new Heathkit computers, robotics, and the future of personal computing. PC

Rated G

The Best Game in Town.

Welcome to ComputerLand. An incredible adventure into the world of personal computers. A one-of-a-kind shopping experience.

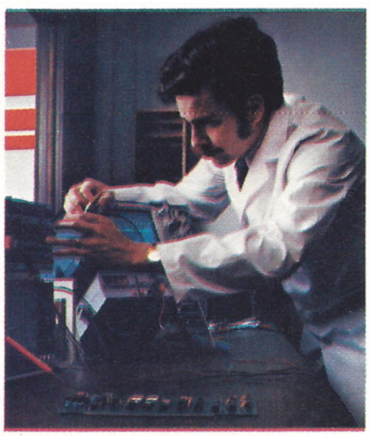
Each ComputerLand store presents everything you ever wanted to know about computers. And then some.

Take our Game Room, for starters. You'll find excitement for the whole family in our endless variety of challenging computer games. You can battle the Klingons in an out-of-this-world game of Star Trek. Create an electronic work of art with a computer controlled TV. Test your skill in a game of computerized hangman.

You can even plot your biorhythm.

But we're more than just fun and games. Each ComputerLand store offers a knowledgeable and personable staff of professionals

to serve you. Plus the greatest available selection of micro components. Whether it's a data processing system for your business or a computer controlled sprinkler system for your home, you'll find whatever you need at ComputerLand.



Read on.

Genuine Service.

We want to supply you with the one system that's right. Rather than a complete system that isn't. Or a limited system that is.

That's why, at ComputerLand, you deal with real professionals who are also real people. People who speak your language . . . in addition to BASIC, COBOL or FORTRAN.

People, in short, who can offer both the novice and the old hand the same expert guidance in selecting the optimum system he or she needs.

Yet, assisting in the purchase is only the beginning of ComputerLand's service. If the kit you bought requires a little more do-it-yourself than you yourself can do, we provide assembly assistance.

If that complex program proves to be just that, we provide programming assistance.

And if your system breaks down, our in-store service department will get you back up and running.

Right now!

Great Selection.

Your first stop at ComputerLand may well be your last stop.

ComputerLand offers the finest quality and largest selection of all the major brand names. Like Apple Computer, Cromemco, DEC, Diablo, Hazeltine, ICOM, IMSAI, Lear Siegler, National Semiconductor, North Star, Texas Instruments, Vector Graphics and more.

Plus a complete inventory of tools, books and accessories.

What's more, at ComputerLand, we deal in product. Not promises. Our inventory is on our own shelves. Rather than the manufacturer's. So you can take delivery on tomorrow's components today.

Which means, simply put, that at ComputerLand, you get exactly what you want.

Exactly when you want it.

Be Our Guest.

Begin with the grand tour of our exhibit areas. "Test-drive" any of our individual systems.

Then tell us your needs. We'll sit down and talk about the system that's right for you. It's as easy as that at ComputerLand.

The great computer store. RATED G.

Call or write for the address of the ComputerLand store nearest you. Franchise opportunities available.

ComputerLand™

1922 Republic Avenue, San Leandro, CA 94577 (415) 895-9363

CIRCLE 20

ready-to-run SOFTWARE REVIEW

by Charles F. Douds

The Digital Group Software Systems offers a ready-to-run 8080/Z-80 BASIC on cassette. I understand that they obtained this BASIC from Northstar, so much of this review probably applies to the BASIC from that source as well.

DGSS has married the BASIC to their operating system so I found that I had a very complete package. Complete, satisfying and easy to use. Not only does the BASIC itself have a wide range of capabilities, but the presence of the operating system greatly enhances the programming possibilities.

The BASIC itself resides from page 0A00 to 33FF thus occupying 10 1/2K of memory. The standard Digital Group operating system (which will be reviewed in another column) is from page 00 to the start of BASIC, 2 1/2K. (The first page, EROM, contains the bootstrap and the TV output routines.)

While the BASIC is written for the 8080, the DGSS provides 1100 baud cassettes for either their 8080 or Z-80 systems. They have two versions because their 8080 and Z-80 operating system programs are not quite the same.

This BASIC will handle all the typical hobbyist applications: games, household bookkeeping and similar items. Many types of engineering applications are suitable, but limited if they require trigonometric functions other than sine and cosine. Of course, the tangent and other trigonometric functions can be easily programmed. The sophisticated user can write his own functions. The interpreter allows up to 286 multiple-line functions to be defined.

Approach business applications with caution if they involve large quantities. While the magnitude of numbers is more than adequate even for scientific work, 10^{-64} to 10^{63}, their accuracy is limited to 8 significant digits, so when you start dealing with anything over $1,000,000.00, you're going to lose some digits at the lower end. If I had over a million bucks, I don't know that I would care about the few cents that can upset accountants. Please note that this limitation applies to most of the BASICs on the market.

Considerable versatility in applications – process control, for instance – is provided by the ability to read and write to input and output ports with INP and OUT; read and write to memory with EXAM and FILL; and to access machine language routines with CALL. The D and E registers are used to pass values to and from machine language routines. When doing this, be sure to think about your numbers properly. The BASIC works with BCD numbers. On the machine language side you will probably be working with hex or octal representation.

Business applications, especially, and many other uses will benefit from the formatted PRINT capability provided. While the name is different, it provides capabilities similar to the PRINT USING statement in other BASICs. For those of you not familiar with the problem, the standard BASIC output can result in unusual appearing columns of numbers. Being able to control the format of the output

means that you can get all of the decimal points to line up with each other. You can also have the format statement insert commas in the usual places in numbers above 999; put a dollar sign in front of the first digit of the number; and for numbers that have several digits to the right of the decimal point, you can suppress trailing zeros. Any or all of these can be combined and can be set to replace the default (or "built-in") format.

It used to be that BASIC could be frustrating to use because it would handle only 26 variables – the letters of the alphabet. This one will handle 286 variables – the single letters plus the combination of a single letter and a number 0 through 9. Actually it will handle five times as many since the same names can be repeated for each of the different kinds of variables: scalar, array, string, numeric functions and string functions.

When you are working with tables of numbers, it is often convenient to put your numbers into arrays with more than one dimension. (An inventory of bolts might have four dimensions: length, size, head type and material.) This BASIC can handle *any* number of dimensions – only watch out! You may run out of memory. To keep track of the quantity of bolts in 10 lengths, 10 sizes, 4 head types and 3 materials would require 6000 bytes of memory just for the array that would be set up by the dimension statement DIM B (10, 10, 4, 3).

"String" operations allow you to do a variety of interesting things with alphabetic characters (including numbers, but treating them in the same way letters are treated). This BASIC has a limited repertoire of string functions – but all the vital ones. Adding a dollar sign to a variable name creates a string variable (e.g., C3$). Any part of a string can be extracted by expressions of the form A$ (N,M). This expression will pull out the Nth through Mth characters in the string. (MITS BASIC uses three different statements to accomplish the same result.) Only one-dimension arrays can be set up, but the effect of two or more dimensions can be achieved by suitably programming the N's and M's. But that does make you do it the hard way.

Some of the early releases had a bug in the VAL function. I asked for help and received a reply in 10 days. The fix is address 037/103=257 and 037/104=002.

Strings can be concatenated – that is, two strings can be "added" to form a new, longer string, a powerful feature when working with alphanumerics or messages.

The MAXI-BASIC control functions include the very convenient "renumber" (REN) command with optional selection of starting number and increment. This means that after debugging a program, which usually results in the line numbers becoming very messy, cleanup is easy. Control-C will stop execution or listing at the end of the current line. Typing mistakes can be corrected by typing a back arrow (Shift-0 on my keyboard) or rubout. An entire line can be deleted during entry by typing an @. I appreciate having error messages written out in full – not abbreviated, not a mysterious code number.

Two convenience features that I like are not having to type PRINT (use # instead) and not having to type LET – it can be omitted. But I found that using the # symbol instead of PRINT meant that I couldn't give a game to a friend who had an Altair. The MITS BASIC and many others will not recognize # as PRINT.

Similarly, there are special features of the MITS BASIC that this one will not accept. The ON statement provides a multi-branched GOTO capability, but you cannot use it with GOSUB as you can in the MITS variety. Nor can you include a LIST within the program; it is sometimes convenient to provide a programmed option for displaying DATA statements. Programs may be SAVEd and LOADed on a cassette, but there is no provision for identifying the program with a letter or other designation.

I asked a knowledgeable friend of mine to check out MAXI-BASIC. I wanted to know if it used memory efficiently in storing programs. He showed me how to check this. (It's not hard to do.) It does save memory by converting line numbers to binary – only two bytes, instead of four, are needed for each line number. Most importantly, it does convert all the standard statement words to a single byte. These are words like FOR, NEXT, REM, GOTO and so on.

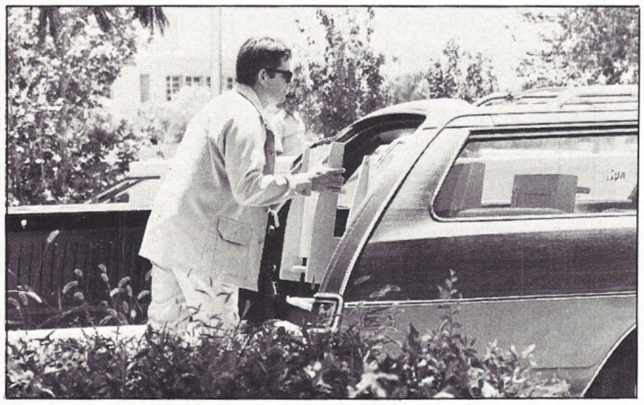
He also pointed out that people like myself can manage to enter some very peculiar lines. When we do, we should get an error statement if the program is well written. He unleashed his "chamber of horrors" tests on MAXI-BASIC and found one that blew up the interpreter so badly that it had to be reloaded. (A free year's subscription to the first person who can find it!) Using MITS BASIC version 3.2 for comparison, he reported that otherwise they were pretty nearly the same. MAXI-BASIC responded properly to some of the things that caused MITS BASIC to hiccup and this one coughed on some of his tests that MITS withstood. He considers anything that causes the interpreter to blow up to be intolerable, but I personally would call it a draw comparing the two on "robustness."

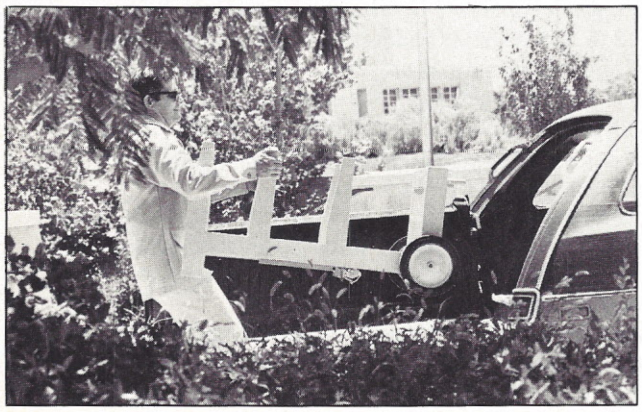
Because DGSS assumes that their program will be run on a Digital Group system, they give no port assignments or I/O addresses in the documentation for the cassette. The operating system (located from 0100 to 09FF) is documented with source code separately, but no source code is given for MAXI-BASIC. A disassembler will be required to locate the I/O addresses within MAXI-BASIC. The Digital Group hardware has no parallel-to-serial conversion; it is done in software. An operating system option provides TTY output with software timing. Port and timing addresses are given in the documentation. Timing at 006/157 for 110 baud should be 035, *not* 034.

Cassettes are available for $15 in computer stores stocking Digital Group equipment or by mail order from DGSS. An extra $5 will supposedly provide an updated version when it is released.

MAXI-BASIC is a reasonably powerful and moderately fast interpreter accompanied by an effective, video-oriented operating system. It does not appear to have any serious limitations for many applications. I have found it pleasurable to use in several programs.

The Lemonade Cart

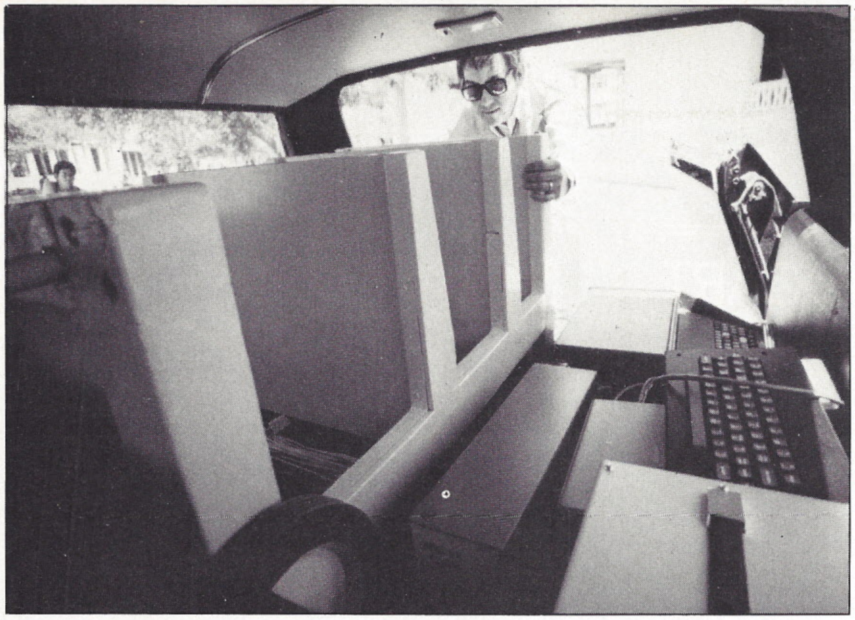




Even lifting the cart back into the station wagon is no real problem. The cart is light enough, and easy enough to grip, so that it can be swung up the couple of feet to the deck, then rolled in on its wheels without throwing the demonstrator's back out of joint. A neat point, considering the quirks of that particular back, and the time spent crawling on the floor as a result of untoward moves with heavy objects.

Yes, microcomputers are small and light, but microcomputer *systems,* with their many elements, tangle of wires, supporting manuals, boxes of cassettes, and miscellaneous bric-a-brac do not readily lend themselves to travel. That's a nuisance, because many computer applications would be enhanced if it were easy to take the system where the action is, or where the action could be if only the computer system were present. (See Gene Dial's CONFEREE article in this issue.) For example, the hospitals are full of people who might gain a great deal of pleasure and value from hands-on experience with personal computing systems, and they represent a sort of captive audience on whom the computer enthusiast can inflict his explanations and demonstrations without much fear of reprisal.

PERSONAL COMPUTING commissioned Kerry Rose, a young New Mexico architect, to whip up a practical cart that any amateur might build at modest cost without elaborate tools. Kerry went through a couple of iterations in constructing a useful cart, then drew up plans with many an explanation that the scheme can be varied and improved without too much effort. There are many ways to degrade the existing plan, too, so major changes should be undertaken only with caution. This particular cart was designed as an almost universal carrier that would accept about any system now on the market, but the builder who knows the exact dimensions of his own equipment can probably make his cart more compact. One drawback of this cart is that it won't fit in the trunk – or even in the back seat of a sedan. A station wagon or hatchback is needed to handle it and all the gear that it carries. Perhaps a custom cart will overcome the drawback, but note that this is nicely balanced, handles well, can be pulled up stairs without straining the gizzard of the puller. Here are plans for a Lemonade Cart.

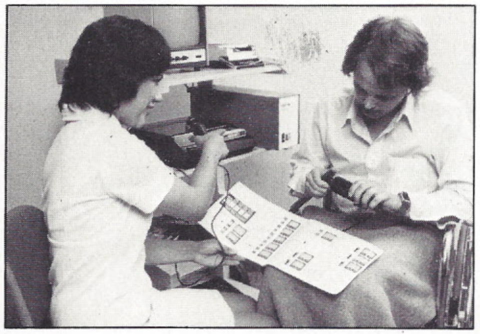


The deck of the station wagon is covered with gear. Why? For a trip to the hospital with a load of electronic cheer. The equipment doesn't have to be piled roof-high, and the cart rolls out easily on arrival.

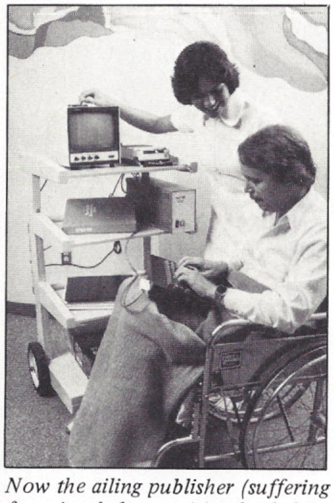
The long, sloping ramp up to the front door makes life easy for cart-pushers, having been designed for wheelchairs.

Although a wide-angle lens makes the cart look enormous, the trip up the steps is no great strain, even with a rather large load. Yes, that's a Processor comfort. A Fairchild videogame outfit is in the box on the shelf above.

"This (cart) is nicely balanced, handles well, can be pulled up stairs without straining . . ."



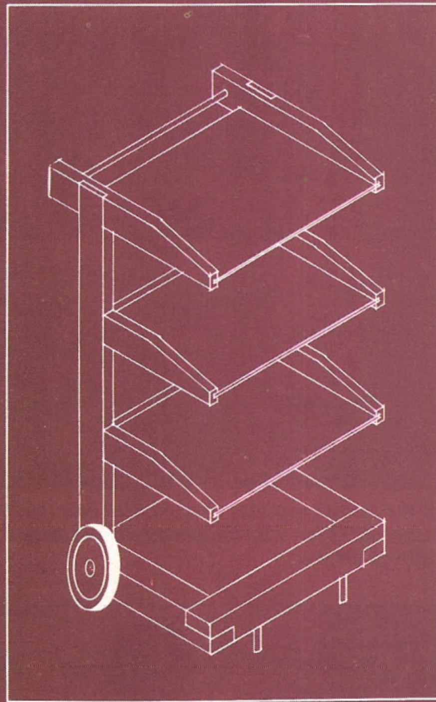
And for a change of pace (probably just an excuse to play kneesies with the angel of mercy) the publisher feigns ignorance of the super Fairchild video game and wins sympathetic aid in operating the system. The Lemonade Cart has proved successful in its field test.



Now the ailing publisher (suffering from jangled nerves) is wheeled in to learn all about computers. How his heart is lifted when he touches the keys on Poly's little keyboard in his lap, and characters appear as if by magic on the monitor screen. He'll be glued to this setup until the cart (or he) is wheeled away

And so grandly through the lobby, escorted by a medical computer enthusiast masquerading as an angel of mercy. The discerning viewer will note that the SOL has been kidnapped from the bottom shelf. It is being held for ransom and entertainment in the office of the hospital administrator near the front entrance. The SOL will be retrieved on departure if the staff has finished the Star Trek game.

THE LEMONADE CART



MATERIALS:

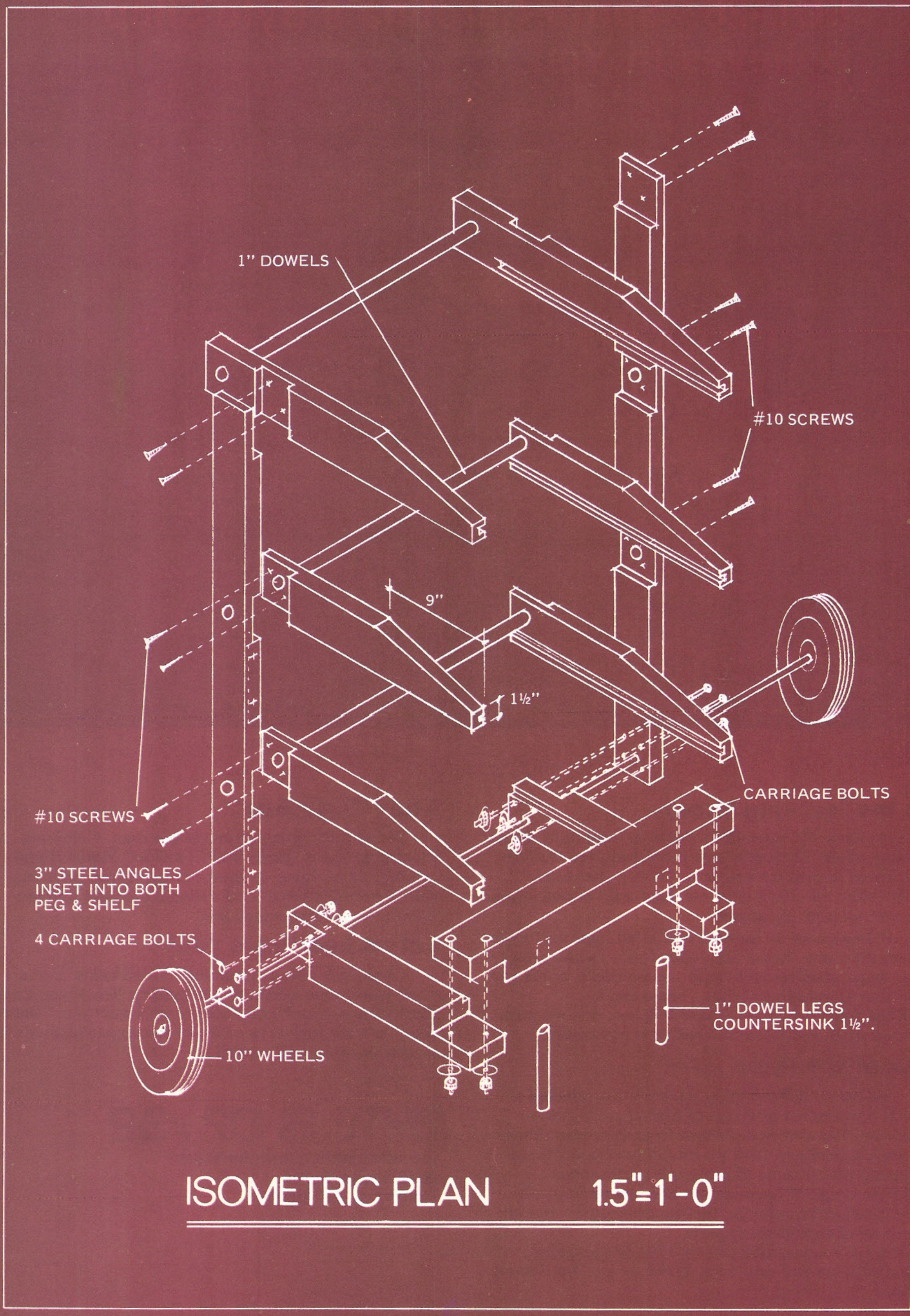
1 - 4x4x6'
3 - 2x4x8'
8' OF 1" DOWEL
12 - 1/4"x4" CARRIAGE BOLTS W/ WASHERS.
12 - #10x1-1/4" WOOD SCREWS
1 - 4'x8' SHEET OF 3/8" PARTICLE BD.*
1 LB. #6d FINISH NAILS
WHEELS & AXLE (1 USED 10" WHEELS)
4 WASHERS — SIZE OF AXLE
4 COTTER PINS
GLUE, WOOD PUTTY, PAINT*

COST: ABOUT $50.00

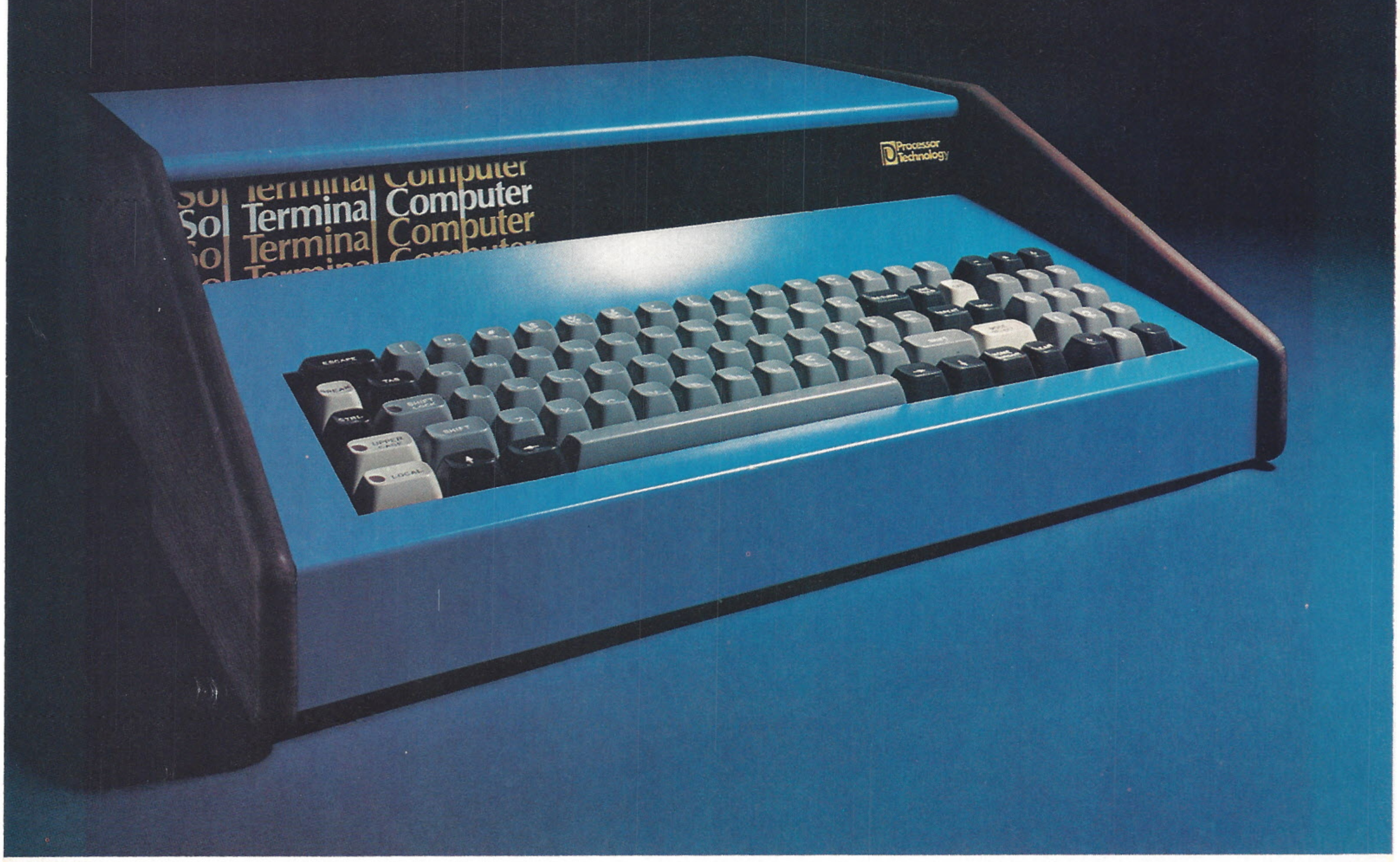
INSTRUCTIONS:

1) CUT 2x4's INTO 2-4' LENGTHS, 4-18" LENGTHS & 2-24" LENGTHS.
2) CUT 4x4 INTO 1-24" LENGTH & 2-18" LENGTH.
3) MAKE LAP JOINTS & 1/2" DADO CUTS. THIS CAN BE ACCOMPLISHED WITH A RADIAL ARM SAW, A 7-1/4" CIRCULAR SAW OR A TABLE SAW.
4) NOW ASSEMBLE JOINTS TO MAKE SURE OF FIT.
5) W/A C-CLAMP, CLAMP CONNECTIONS TOGETHER ONE AT A TIME & DRILL HOLES FOR DOWELS. REMEMBER A 1" DOWEL HOLE MEANS YOU DRILL WITH AN 11/16" BIT TO ASSURE A GOOD TIGHT ASSEMBLAGE. FOLLOW SAME RULE FOR CARRIAGE BOLTS.
6) OUT OF THE PARTICLE BD. SHEET CUT 3-18"x22" SHELVES & 1-14½"x19". SLIDE THEM INTO DADOS. SHORT SHELF ON BOTTOM.
7) ALSO CUT DOWELS INTO 3-24" LENGTHS & 2-6½" LENGTHS.
8) IF AXLE IS STEEL ROD OR REBAR, TWO 1/8" HOLES WILL HAVE TO BE DRILLED INTO EACH END ON EACH SIDE OF THE WHEELS. THESE ARE FOR COTTER PINS.
9) ONE SIDE @ A TIME, ASSEMBLE CART. USE GLUE ON ALL JOINTS TO SECURE THEM. SCREWS MAY BE COUNTERSUNK SLIGHTLY & CAPPED OR PUTTIED OVER.
10) AFTER PUTTING TOGETHER ALL BUT WHEELS & ATTACHING THEM, PUTTY UNSIGHTLY CRACKS, JOINTS, ETC. LET DRY AN HOUR OR SO & SAND.
11) NOW PAINT W/ PRIMER; LET DRY. THEN PAINT W/ AN ENAMEL. IT MAY TAKE 2 OR 3 COATS.
12) PUT AXLE THROUGH ITS HOLE, THEN A WASHER, THEN WHEEL, WASHER, & LAST COTTER PIN.
13) YOU MAY HAVE TO TRIM LEGS TO GET CART LEVEL.
14) FINIS — A LEMONADE COMPUTER CART.

*SHELVES MAY BE PLYWOOD & A STAIN USED INSTEAD OF PAINT. ALSO DIMENSIONS CAN BE ALTERED TO FIT YOUR SYSTEM. NOTE: STEEL CORNER BRACES MAY BE REQUIRED AS SUPPORTS IF COMPUTER SYSTEM IS EXCESSIVELY HEAVY.


1" DOWELS
#10 SCREWS
9"
1½"
CARRIAGE BOLTS
#10 SCREWS
3" STEEL ANGLES
INSET INTO BOTH
PEG & SHELF
4 CARRIAGE BOLTS
1" DOWEL LEGS
COUNTERSINK 1½".
10" WHEELS
ISOMETRIC PLAN 1.5"=1'-0"

SOL-20, South Carolina's Byte Shop Believes In You . . .



Up the learning curve

Byte Shop #32 opened its doors in Columbia, South Carolina about 10 months ago (now there are over 70 Byte Shops across the country). During that time, we've sold a lot of systems, serviced a lot of machines, and learned a lot of lessons.

One lesson we've learned is that all manufacturers are not the same. Some are dependable - some aren't. Some make good reliable units - some don't. Some can back their advertising claims - some can't.

Experience has been a hard teacher, and we want to share what we've learned with our customers.

Pick of the litter

Based on our experiences, we have selected a very few preferred products of high quality manufacturers - like this SOL-20 unit from Processor Technology Corporation. And we intend to support those preferred products by offering our customers a complete range of back-up services - including software, product knowledge, testing procedures and an inventory of replacement parts.

We have a carefully selected list of preferred manufacturers and products. Write us and we'll name names.

The "Data Bus"

We're putting our show on the road. Columbia Byte Shop has a "Data Bus" - a GMC Motor Home - completely outfitted to show our preferred products with a combination of audio-visual displays and live "hands-on" demonstrations.

Let us hear from you!

Circle the "Bingo Number" listed below if you want your name added to our mailing list. If you live in the Southeastern United States, and want our "Data Bus" to visit your area or if you have special needs for a prompt reply, call or write:

BYTE SHOP™ #32

the affordable computer store
2018 Green Street
Columbia, SC 29205

conferee

BY GENE DIAL

the problem

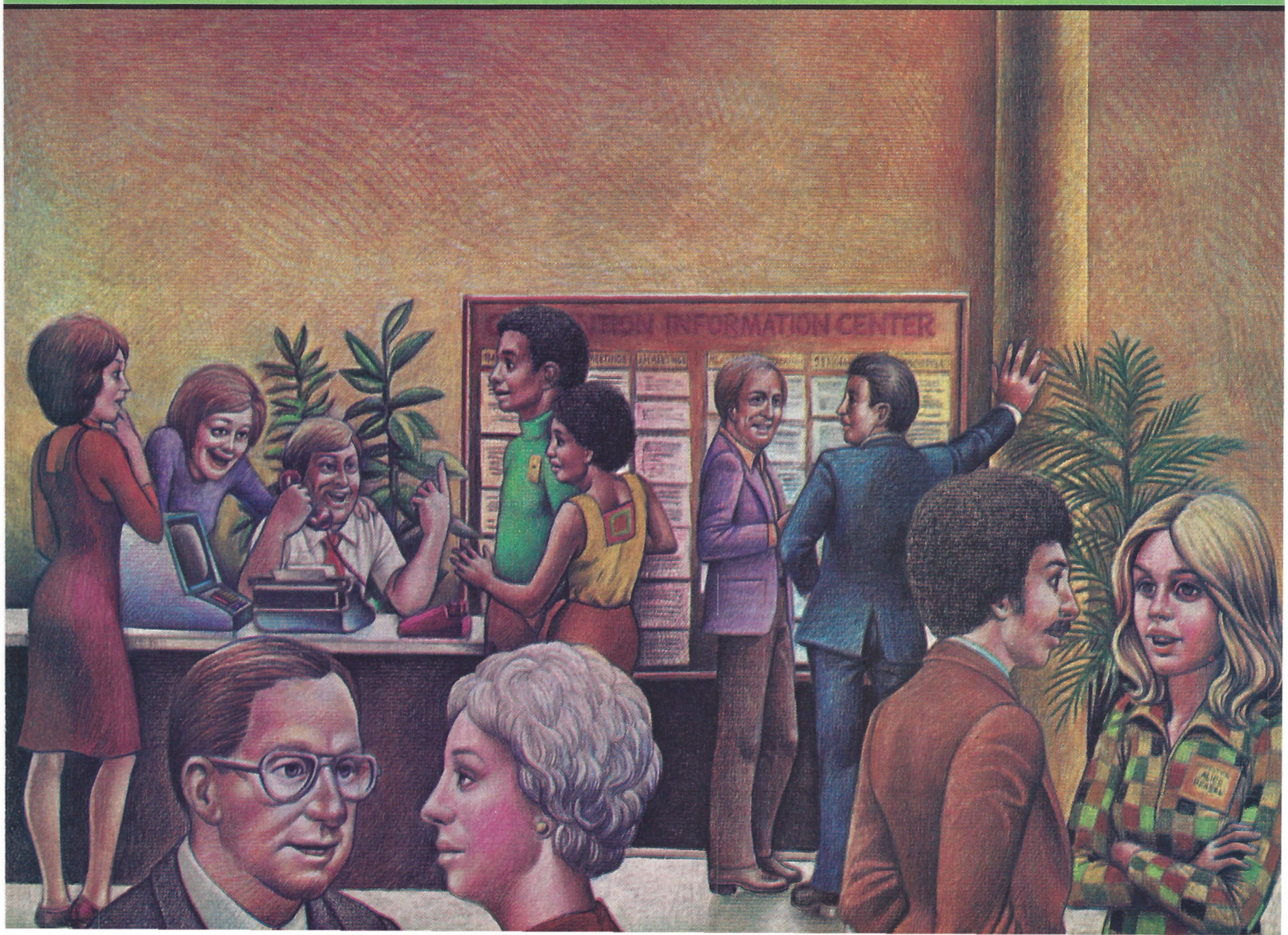
There are thousands of associations in the United States whose members come from the four corners of the country to meet once or more each year. Usually, these conventions target on our major cities to find hotels large enough to accommodate them. Even so, convention members must usually be distributed among a number of large hotels before their space requirements can be met.

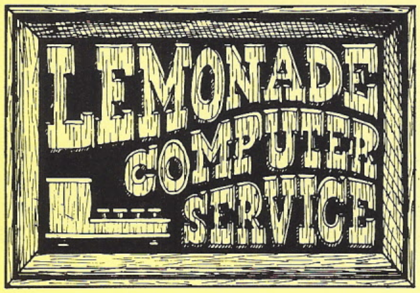
This causes problems. Who's staying where? The telephone company will sometimes establish a message center, but their requirements in terms of minimum number participating, the lead time on furnished listings, and so on, preclude the use of this service more often than not.

Then, too, the hidden agenda of almost every convention involves getting together smaller groups of the attendees for special purposes. You might want to assemble the presidents of regional sections, or the board of directors, or those attending from a particular city or organization. You may want to reach people with a particular occupational title. But who are they, and how do you find them?

You may need a listing of attendees together with addressing information and phone numbers to take home from the conference for later use. Typically, by the end of a convention, it becomes possible to get a list of attendees, but very little additional information.

Finally, there is the problem of exchanging messages. The conference staff will usually operate a message center in the conference registration area. It is highly organized in the beginning, with messages appearing in alphabetical order by addressee. This quickly deteriorates as more and more messages appear, and few are removed; the alphabetical order convention gives way to simply finding a space to tack on the message. By the second day one must scan the entire board to find messages.





Like kids' lemonade stands, very small entrepreneurial ventures with personal computers may produce little profit, but much useful experience, beguiling cash flow, and heartwarming respectability.

```
LIST 'CONFEREE'    O. E. DIAL    JULY, 1977

10 CLEAR200
20 WIDTH 132
30 INPUT 'DO YOU DESIRE RUNNING INSTRUCTIONS'; D$: PRINT
40 IF LEFT$(D$,1)<>'Y' THEN 330
50 CONSOLE 18,0'         * * CHANGE TO THE PRINTER PORT
60 '                         ASSUMES THE CRT PORT WAS IN USE.
70 '
80 PRINT:PRINTTAB(20)'* * * CONFEREE * * *':PRINT
90 '
100 PRINT TAB(5)'THIS PROGRAM PERMITS YOU TO MAKE LISTINGS OF YOUR CONFEREES'
110 PRINT'AT PERIODIC INTERVALS ON REGISTRATION DAY OF YOUR CONFERENCE.'
120 PRINT'THE LISTINGS MAY BE SORTED IN A VARIETY OF WAYS, AS SUGGESTED'
130 PRINT'FURTHER BELOW.':PRINT
140 '
150 '                    * * DATA STATEMENT FORMATS
160 '
170 PRINT'ENTER DATA AS DATA STATEMENTS APPENDED TO THIS PROGRAM, ALLOWING'
180 PRINT'THREE STATEMENTS FOR EACH NAME.':PRINT
190 PRINT'USE THE FOLLOWING FORMAT:':PRINT
200 PRINTTAB(5)'FIRST LINE - NAME IN QUOTES AND LAST NAME FIRST, THEN A'
210 PRINT TAB(5) 'COMMA AND POSITION TITLE':PRINT
220 PRINTTAB(5)'SECOND LINE - ORGANIZATION, COMMA, THEN HOME STREET ADDRESS':PRINT
230 PRINTTAB(5)'THIRD LINE - HOME CITY, COMMA, STATE, COMMA, ZIP, COMMA, AND'
240 PRINT TAB(5) 'LOCAL ADDRESS':PRINT
250 PRINT'ENTER AN 'EOF' STATEMENT AT THE END OF THE FILE.':PRINT:PRINT
260 PRINT'THEN ENTER ANY MESSAGES YOU MAY HAVE--NAME IN QUOTES AND LAST'
270 PRINT'NAME FIRST, COMMA, THEN THE MESSAGE IN QUOTES--ALL IN ONE'
280 PRINT'DATA STATEMENT.':PRINT
290 PRINT'AGAIN, ENTER AN 'EOF' AS THE LAST STATEMENT.':PRINT:PRINT
300 PRINT TAB(5) 'WE RECOMMEND THAT 'CONFEREE' BE SAVED ON DISKETTE AFTER EACH'
310 PRINT 'UPDATE.  YOU MAY DO THIS BY THE INSTRUCTION 'RUN 3040'.': PRINT: PRINT
320 CONSOLE16,0'         * * TO RETURN TO THE CRT
330 PRINT TAB(16) '* NOW READING FILES *':PRINT
340 '
350 '                    * * ALL DATA IS NOW READ IN ORDER TO GET COUNTS
360 '                        OF THE NUMBER OF PARTICIPANTS AND MESSAGES.
370 '
380 '
390 '           * * READ THE CONFEREE FILE
400 '
410 READ A$
420 IF A$ <> 'EOF' THEN O=O+1: GOTO 410
430 O=INT(O/8-1)'        * * SINCE THERE ARE 8 ELEMENTS IN EACH NAME ARRAY (O)
440 '
450 '           * * READ THE MESSAGE FILE
460 '
470 READ B$
480 IF B$ <> 'EOF' THEN P=P+1: GOTO 470
490 P=INT(P/2-1)'        * * SINCE THERE ARE 2 ELEMENTS IN EACH MESSAGE ARRAY (P)
500 '
510 '                    * * NOW THAT WE HAVE THE COUNT, WE CAN COMPLETE
520 '                        THE DIMENSION STATEMENT AND READ THE DATA
530 '                        INTO THE MATRIX.
540 '
550 DIM A$(O,7), B$(P,2)
560 RESTORE'             * * TO SET THE POINTER BACK TO THE BEGINNING OF
570 '                        THE DATA FILE.
580 '
590 '                    * * THE 'READ NAMES' LOOP
600 '
610 FOR J = 0 TO O
620     FOR K = 0 TO 7
630             READ A$(J,K)
640 NEXT K,J
650 READ E$'             * * E$ IS THE 'EOF' FLAG
660 '
670 '
680 '                    * * THE 'READ MESSAGES' LOOP
690 '
700 FOR J = 0 TO P
710     FOR K = 0 TO 1
720             READ B$(J,K)
730 NEXTK,J
740 '
750 '                    * * FILE VERIFICATION
760 '
770 INPUT 'DO YOU WANT TO VERIFY THE FILES';E$: PRINT: PRINT
780     IF LEFT$(E$,1)<>'Y' THEN 910
790 '
800 '                    * * PRINT OUT THE DATA  FILES FOR EDITING
810 '
820 CONSOLE 18,0'        * * TO RETURN TO THE PRINTER
830 FOR J=0 TO O
840     PRINT J+1; A$(J,0) TAB(30) A$(J,1) TAB(60) A$(J,2) TAB(95) A$(J,3)
850     PRINT A$(J,4) TAB(30) A$(J,5) TAB(60) A$(J,6) TAB(95) A$(J,7): PRINT
860 NEXT J
870 '
880 '                    * * PRINTOUT SELECTION
890 '
900 CONSOLE 16,0'        * * TO RETURN TO THE CRT
```

Furthermore, the messages are rarely time-dated, so that a check of the board yields no clue as to when the message was posted.

All of these problems and frustrations fall ultimately on conference staffs, hotel assistant managers, telephone operators, and desk clerks. There is a substantial overhead in terms of time, expense, and emotion that few hotels welcome, yet must accept. In-house means for automating the problem and its solution are rarely available – surprisingly.

Just what is the magnitude of the problem? Well, Denver alone accommodates each year some 300 conventions which are national in scope. Each of the larger hotels in Denver accommodates from seven to ten of these every month, on the average. There is a large measure of cooperation among the hotels in order to get everyone registered into rooms, but the problem of knowing who is registered where persists.

enter the lemonade computer service

All of this is by way of introducing the LEMONADE COMPUTER SERVICE to one more marketing area which is very much in need of its services. As a Lemonade Entrepreneur, you can maintain liaison with the city's "Visitors and Convention Bureau" and the major hotels, keeping informed of forthcoming conventions of sufficient size to require Lemonade service. Discover in each instance the names of the local "arrangements committee" that each convention normally employs. Offer your service for a fee and if the offer gets a warm reception, get down to an agreement as to the kind of listings which will be desired, and how often the updates to these listings should be posted. If a contract is made, take your place at the conference registration desk at the appointed hour and day, and begin to collect the data you will need from each registrant. Then produce the desired listings for each of the agreed-upon time cycles.

a field test

Simple? Well, conceptually it is very simple. In practice certain problems should be anticipated, as a field test of CONFEREE quickly revealed. CONFEREE is a program which permits ordering and re-ordering of data to yield any of the following five listings: Conferees in alphabetical order; alphabetical order by ZIP within city, city within state, and by state; alphabetical order by organization; alphabetical order by

position title; messages in alphabetical order by addressee. CONFEREE can easily be adapted to local requirements by changing the number of fields on DATA statements, or by changing the definitions of the fields which are used.

To test the concept and the feasibility of CONFEREE, I offered to provide the service to the Western Social Sciences Association, meeting for a two-day period in the Cosmopolitan Hotel in Denver a few months ago. The arrangements committee was delighted to have the service, and space was made available near the registration desk for me, my assistant, and the required hardware. Only a part of the information I required of each registrant was available from the forms then in use, so the remainder was to be collected as each registrant filed by.

Unfortunately, we were not located near enough to the registration desk; many registrants escaped without supplying the information we required. Further, some registered for the convention before registering for a room, and thus were unable to provide a local address. Very few followed up to supply this information at a later time.

A second problem of some consequence became evident when, for example, we found that our first listing sorted data under North Dakota, then more under "N.D.", and still another heading "ND". We got two listings under Illinois simply because in one instance a period had been inadvertently placed after the word.

Closely allied to this problem were variations in identifying the name of a university, business, or some other organization. We produced multiple listings of the same organization simply because of variations in identifying the organization in the data base. This was a problem in selective abbreviations.

These problems resulted in a quick editing of the data base to reflect newly devised standards. It was a bad time to do it, a time when new data was continually arriving, but it was done.

As this leak was plugged up, a new one appeared; we had not anticipated the problem of dealing with missing data. We had merely decided to place a star in any field for which data was missing. This resulted in the generation of listings under starred captions. Take position title, for example. The star will sort to the top, taking precedence over alpha characters. This meant that our listing began with a captioned star, and a listing of all individuals under the star who had not supplied the titles of their positions. This result was not

```
910 PRINT "PLEASE INDICATE, BY NUMBER, THE KIND OF LISTING YOU WANT"
920 PRINT "AT THIS TIME:":PRINT
930 PRINT TAB(3) "1 - CONFEREES IN ALPHABETICAL ORDER":PRINT
940 PRINT TAB(3) "2 - CONFEREES IN ALPHABETICAL ORDER BY ZIP WITHIN CITY, AND CITY
950 PRINT "WITHIN STATE, BY STATE":PRINT
960 PRINT TAB(3) "3 - CONFEREES IN ALPHABETICAL ORDER, BY ORGANIZATION ":PRINT
970 PRINT TAB(3) "4 - CONFEREES IN ALPHABETICAL ORDER, BY POSITION TITLES":PRINT
980 PRINT TAB(3) "5 - MESSAGES RECEIVED, BY ADDRESSEE"
990 INPUT G: PRINT: PRINT
1000 '
1010 PRINT: INPUT "PAPER POSITIONED";D$: PRINT: PRINT
1020 PRINT TAB(10)"* * * NOW SORTING * * *": PRINT: PRINT
1030 J=0: K=0: M=7'      * *  INITIALIZATION
1040 CONSOLE 18,0'      * * TO RETURN TO THE PRINTER
1050 ON G GOTO 1070, 1080, 1090, 1100, 1110
1060 '
1070 GOSUB 1500: GOTO 900'      * * CONFEREES IN ALPHABETICAL ORDER --SR(1)
1080 GOSUB 1640: GOTO 900'      * * BY ZIP WITHIN CITY, CITY, STATE, AND BY STATE--SR(2)
1090 GOSUB 1950: GOTO 900'      * * BY ORGANIZATION--SR(3)
1100 GOSUB 2230: GOTO 900'      * * BY POSITION TITLE--SR(4)
1110 GOSUB 1150: GOTO 900'      * * MESSAGE FILE--SR(5)
1120 '
1130 '                    * * SORT MESSAGES BY NAME OF ADDRESSEE
1140 '
1150 Z=P
1160 FOR J =0 TO P
1170    Z=Z-1
1180    F = 0'           * * TO RESET THE FLAG
1190    FOR L = 0 TO Z
1200            IF B$(L,0) <= B$(L+1,0) THEN 1250
1210            FOR X = 0 TO 1
1220                    SWAP B$(L,X), B$(L+1,X)
1230            NEXT X
1240            F = 1
1250    NEXT L
1260    IF F = 0 THEN 1310
1270 NEXT J
1280 '
1290 '                    * * PRINT MESSAGE SUBROUTINE (5)
1300 '
1310 CONSOLE 16,0
1320 INPUT "MESSAGES TIME-DATE (IN QUOTES):";C$:PRINT
1330 INPUT"PAPER POSITIONED";D$
1340 CONSOLE 18,0
1350 C=INT(53-LEN(C$)/2)'* * TO CENTER THE 'TIME-DATE'
1360 GOSUB 2720
1370 PRINT TAB(C) "MESSAGES RECEIVED AS OF " C$: PRINT
1380 GOSUB 2910: PRINT: PRINT
1390 FOR J = 0 TO P
1400    PRINT "MESSAGE FOR:    " B$(J,0)
1410    FOR L = 1 TO 14 + LEN(B$(J,0))
1420            PRINT "-";
1430    NEXT L: PRINT
1440    PRINT B$(J,1):PRINT "PLEASE INITIAL IF MESSAGE HAS BEEN RECEIVED SO THAT IT MAY";
1450 PRINT" BE DELETED FROM THE LISTING.  !    !":PRINT:PRINT:PRINT
1460 NEXT J: PRINT: PRINT: RETURN
1470 '
1480 '                    * * PRINTOUT SUBROUTINE (1)
1490 '
1500 GOSUB 2510'          * * THE SORT KEY (K) HAS BEEN INITIALIZED TO ZERO,
1510 '                        HENCE THE FIRST SORT WILL BE BY LAST NAME.
1520 GOSUB 2720
1530 PRINT TAB(47) "* CONFEREES IN ALPHABETICAL ORDER *": PRINT
1540 GOSUB 2910
1550 GOSUB 2860
1560 FOR J = 0 TO O
1570    GOSUB 2980
1580 NEXT J
1590 CONSOLE 16,0
1600 RETURN
1610 '
1620 '                    * * PRINTOUT SUBROUTINE (2)
1630 '
1640 GOSUB 2510: K=6'   * * THESE ARE THE SORT KEYS
1650 GOSUB 2510: K=4
1660 GOSUB 2510: K=5
1670 GOSUB 2510
1680 GOSUB 2720
1690 PRINT TAB(38)"* CONFEREES BY ZIP WITHIN CITY, AND CITY WITHIN STATE *": PRINT
1700 GOSUB 2910
1710 GOSUB 2860
1720 '
1730 FOR I = 0 TO O'    * * STARS INDICATE MISSING DATA IN THE KEY FIELD.  THESE ARE SORTED
1740    IF A$(I,5)<>"*" THEN 1770'TO THE TOP.  THUS THIS LOOP ENSURES THEY WILL BE OMITTED.
1750 NEXT I
1760 '
1770 PRINT A$(I,5)
1780 FOR L= 1 TO LEN(A$(I,5))'  ** TO PROVIDE UNDERSCORING FOR THE KEY FIELD TITLE.
1790    PRINT "-";
1800 NEXT L: PRINT
1810 '
1820 FORJ=I TO O'         * * THE VALUE OF I IS CARRIED FORWARD FROM 1740, AND THUS IS THE
1830    GOSUB2980'            FIRST RECORD FOR WHICH DATA IS SUPPLIED IN THE KEY FIELD.
1840    IF J = O THEN 1890 ELSE IF A$(J,5)=A$(J+1,5) THEN 1890
1850    PRINT A$(J+1,5)
1860 FOR L = 1 TO LEN(A$(J+1,5))'* * TO PROVIDE UNDERSCORING FOR THE KEY FIELD TITLE.
1870    PRINT "-";
1880 NEXT L: PRINT
1890 NEXT J
1900 CONSOLE 16,0
1910 RETURN
1920 '
1930 '                    * * PRINTOUT SUBROUTINE (3)
1940 '
1950 GOSUB 2500: K=2
1960 GOSUB 2500
1970 GOSUB 2720
1980 PRINT TAB(46) "* CONFEREES ACCORDING TO ORGANIZATION *":PRINT
1990 GOSUB 2910
2000 GOSUB 2860
2010 FOR I = 0 TO O
2020    IF A$(I,2)<>"*" THEN 2040
2030 NEXT I
2040 PRINT A$(I,2)
2050 FOR L = 1 TO LEN (A$(I,2))
2060    PRINT"-";
```

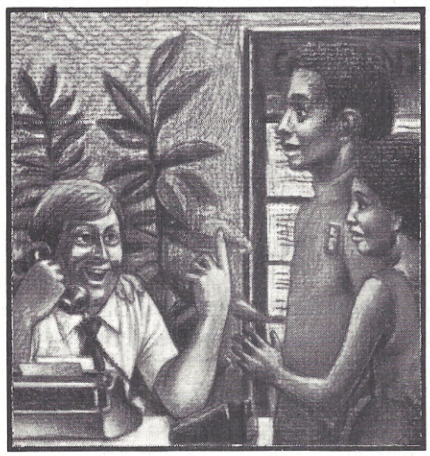
```
2070 NEXT L: PRINT
2080 FOR J=0 TO 0
2090    GOSUB 2980
2100    IF J = 0 THEN 2170 ELSE IF A$(J,2) = A$(J+1,2) THEN 2170
2110    PRINT
2120    PRINT A$(J+1,2)
2130    FOR L = 1 TO LEN (A$(J+1,2))
2140            PRINT "-";
2150    NEXT L
2160    PRINT
2170 NEXT J
2180 CONSOLE 16,0
2190 RETURN
2200 '
2210 '                  * * PRINTOUT SUBROUTINE (4)
2220 '
2230 GOSUB 2500: K=1
2240 GOSUB 2500
2250 GOSUB 2720
2260 PRINT TAB(50) "* CONFEREES ACCORDING TO TITLE *": PRINT
2270 GOSUB 2910
2280 GOSUB 2860
2290 FOR I = 0 TO 0
2300    IF A$(I,1)<>"*" THEN 2320
2310 NEXT I
2320 PRINT A$(I,1)
2330 FOR L = 1 TO LEN (A$(I,1))
2340    PRINT"-";
2350 NEXT L
2360 PRINT
2370 FOR J = 0 TO 0
2380    GOSUB 2980
2390    IF J = 0 THEN 2450 ELSE IF A$(J,1) = A$(J+1,1) THEN 2450
2400    PRINT A$(J+1,1)
2410    FOR L = 1 TO LEN (A$(J,1))
2420            PRINT "-";
2430    NEXT L
2440    PRINT
2450 NEXT J
2460 CONSOLE 16,0'      * * TO RETURN TO THE CRT
2470 RETURN
2480 '
2490 '                  * * * THE SORT SUBROUTINE
2500 '
2510 Z=0
2520 FOR J = 0 TO 0
2530    Z=Z-1'          * * REDUCES THE SORT LENGTH BY 1 FROM THE TOP DOWN
2540 '                      WITH EACH COMPLETE PASS.
2550    F=0'            * * TO RESET THE FLAG EACH TIME AN 'L' LOOP HAS BEEN COMPLETED.
2560    FOR L=0 TO Z
2570            IF A$(L,K) <= A$(L+1,K) THEN 2650
2580 '                  * * NOTE THAT ALL ELEMENTS OF THE ARRAY MUST BE EXCHANGED.
2590 '
2600            FOR X = 0 TO M
2610 '
2620                    SWAP A$(L,X), A$(L+1,X)
2630            NEXT X
2640            F = 1'  * * TO SET THE FLAG, THUS INDICATING AN EXCHANGE HAS TAKEN PLACE.
2650    NEXT L
2660    IF F = 0 THEN 2680
2670 NEXT J
2680 RETURN
2690 '
2700 '                  * * PRINT A STANDARD HEADING SUBROUTINE
2710 '
2720 GOSUB 2790
2730 PRINT TAB(51) "* * * CONFEREE LOCATOR * * *": PRINT
2740 GOSUB 2790
2750 RETURN
2760 '
2770 '                  * * THE 'DOUBLE UNDERSCORE' SUBROUTINE
2780 '
2790 FOR J = 1 TO 130
2800    PRINT"=";
2810 NEXT J: PRINT: PRINT
2820 RETURN
2830 '
2840 '                  * * THE TITLING SUBROUTINE
2850 '
2860 PRINT TAB(3) "NAME" TAB(25) "TITLE" TAB(50) "ORGANIZATION" TAB(84);
2870 PRINT "ADDRESS" TAB(110) "CONFERENCE ADDRESS"
2880 '
2890 '                  * * THE 'SINGLE UNDERSCORE' SUBROUTINE
2900 '
2910 FOR J=1 TO 130
2920    PRINT"-";
2930 NEXT J: PRINT
2940 RETURN
2950 '
2960 '                  * * THE 'PRINT' SUBROUTINE
2970 '
2980 PRINT A$(J,0) TAB(22) A$(J,1) TAB(47) A$(J,2) TAB(81) A$(J,3) TAB(113);
2990 PRINT A$(J,7): PRINT TAB(81) A$(J,4)", "A$(J,5)"  "A$(J,6): PRINT
3000 RETURN
3010 '
3020 '                  * * SAVE ON DISKETTE SUBROUTINE
3030 '
3040 SAVE "CONFEREE" : STOP
3050 '
3060 '                  * * THE DATA FILES--NAME DATA THEN MESSAGES DATA.
3070 '
3080 '
3090 '                  * * PLEASE NOTE THAT LAST NAMES OF CONFEREES HAVE BEEN JUXTAPOSED
3100 '                      WITH REMAINING DATA TO ENSURE PRIVACY FOR PURPOSES OF THIS
3110 '                      ILLUSTRATION.  STARS INDICATE MISSING DATA.
3120 '
3130 '
3140 DATA"LAYDEN,MIKE",PROF
3150 DATAUNIV OF NEVADA AT RENO,804 GEAR
3160 DATARENO,NEVADA,89503,COSMO-928
3170 DATA"REED,DIANNE",STAFF
3180 DATABERNALILLO CTY MED CTR,2211 LOMAS NE
3190 DATAALBUQUERQUE,NEW MEXICO,87106,*
3200 DATA"LUSK,ROBERT M.",VICE-CHAIRMAN
3210 DATABRD OF COMM. COUNTY OF BERNALILLO,*
3220 DATAALBUQUERQUE,NEW MEXICO,87102,*
```

intended, and the problem was quickly solved by programming a "star filter." (See statements 1740, 2020 and 2300.)

A further problem which was not anticipated was the accretion of messages without procedures for their removal. This was solved by programming a line which requested the recipient of a message to initial his message when it was received. We then deleted the message from the data base.

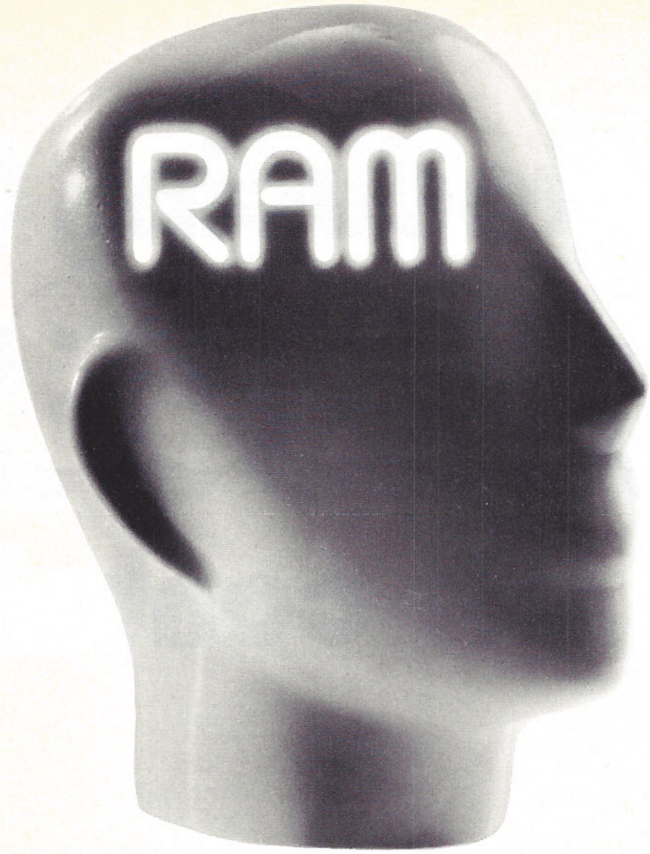
Our original plan to provide an updated listing each hour and messages each half-hour deteriorated to updates of both kinds each 90 minutes. The sort-time required for each listing, except messages, ran five to ten minutes. Messages required only ten seconds or so. But this did mean that about 40 minutes machine time was required for the production of updated listing. Meanwhile, the entry of new data was delayed. Even so, the 90-minute cycle worked rather well.

Finally, the program is memory intensive. The sort routine works



with an 8xN matrix, where "N" is the number of conferees. Although 36K bytes of memory were available, the MITS 4.0 Disk BASIC Interpreter consumed 19.1 K, and the CONFEREE Program required 15.4K in its passive state. This left only 1,485 bytes for the run. Program requirements will, of course, increase in direct proportion to the addition of DATA statements. For each run we first asked "PRINT FRE (0)", and read the reply with some concern. We were marginally close to being out of memory by the conclusion of the conference. So close, in fact, that I would not attempt the service again without reducing the number of fields and sorts in the program; or, better, adding memory, up to the 60K plus limit.

A final caution derived from experience – you should anticipate the need for a great amount of wall space on which to post the listings. Four of the



LOOK!!
we've added to the family

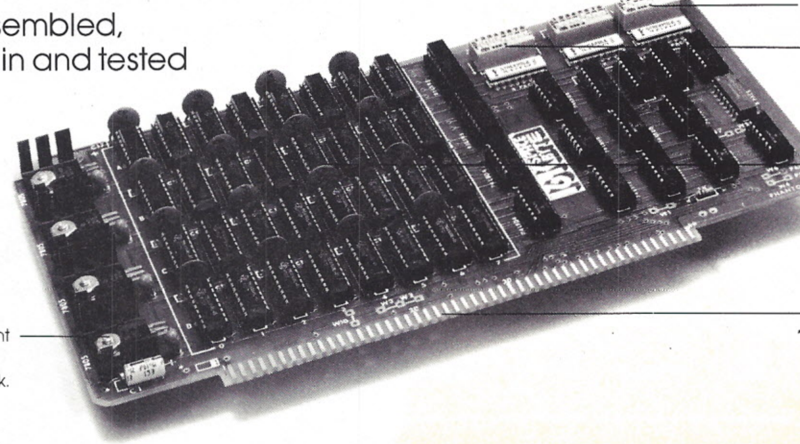
fold here

There are only 2 types of memory. yours and ours.

Ours is the 16K SPACE BYTE™

A fully static, state of the art RAM

$599. Fully assembled, burned in and tested



Addressable in 4K blocks at any 4K border by dip switch...as if you had 4 individual 4K static boards

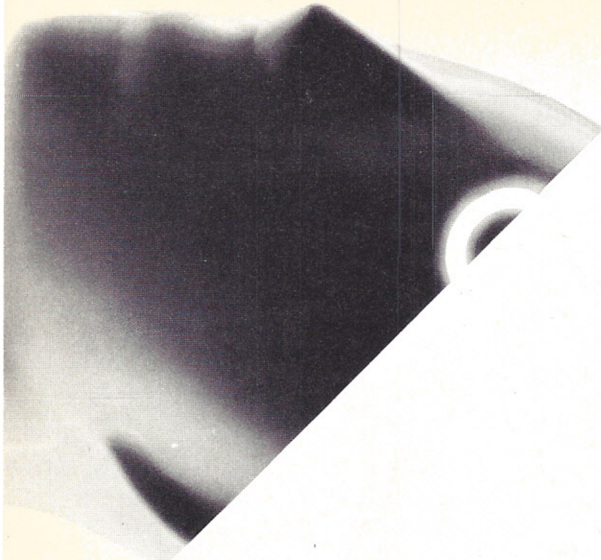
Memory write protect and memory disable (phantom) are controllable in 4K blocks by dip switch

The state of the art TMS-4044 (4K by 1 bit) fully static RAM by Texas Instruments

The all popular S100 bus... The 16K SPACE BYTE is fully compatible with the VECTOR 1, ALTAIR, SOL-20, IMSAI, POLY-88, Z-80, COMPAL-80, and AM-100 (DMA DISK)

Single +8 volt power requirement 4 independent 7805 voltage regulators, one for each 4K block. Typical worst case power dissipation is less than 2 amps

CIRCLE 21



Introducing t

SPACE BYTE™ 808

A self-contai

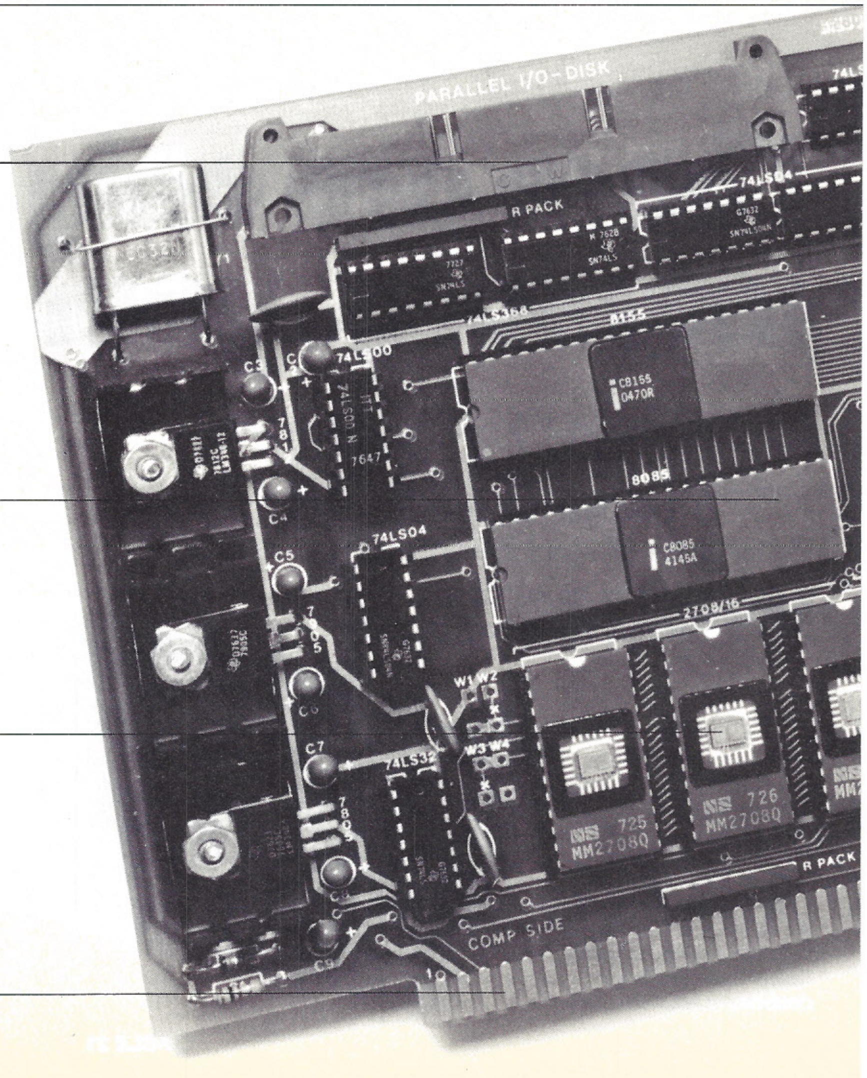
Two RS-232C serial I/O ports—a CRT in one and a printer in the other with software selectable baud rates

Fully buffered parallel I/O ports interface directly with the ICOM® FD 3700 or Frugal Floppy disk systems

The state of the art INTEL® 8085 CPU is 50% faster than the 8080A. It operates at 3MHz, using 450 ns memory and is fully compatible with all existing 8080 software

Complete 3K system monitor with 2708* EPROMS including extensive de-bugging, fdos, tarbell and video driver routines. *Jumper selectable for use with 2716 EPROMS for up to 6K of on board system monitor

The all popular S100 bus...



```
RUN
DO YOU DESIRE RUNNING INSTRUCTIONS? YES

                    * * * CONFEREE * * *

     THIS PROGRAM PERMITS YOU TO MAKE LISTINGS OF YOUR CONFEREES
AT PERIODIC INTERVALS ON REGISTRATION DAY OF YOUR CONFERENCE.
THE LISTINGS MAY BE SORTED IN A VARIETY OF WAYS, AS SUGGESTED
FURTHER BELOW.

ENTER DATA AS DATA STATEMENTS APPENDED TO THIS PROGRAM, ALLOWING
THREE STATEMENTS FOR EACH NAME.

USE THE FOLLOWING FORMAT:

     FIRST LINE - NAME IN QUOTES AND LAST NAME FIRST, THEN A
     COMMA AND POSITION TITLE

     SECOND LINE - ORGANIZATION, COMMA, THEN HOME STREET ADDRESS

     THIRD LINE - HOME CITY, COMMA, STATE, COMMA, ZIP, COMMA, AND
     LOCAL ADDRESS

ENTER AN 'EOF' STATEMENT AT THE END OF THE FILE.


THEN ENTER ANY MESSAGES YOU MAY HAVE--NAME IN QUOTES AND LAST
NAME FIRST, COMMA, THEN THE MESSAGE IN QUOTES--ALL IN ONE
DATA STATEMENT.

AGAIN, ENTER AN 'EOF' AS THE LAST STATEMENT.


     WE RECOMMEND THAT 'CONFEREE' BE SAVED ON DISKETTE AFTER EACH
UPDATE.  YOU MAY DO THIS BY THE INSTRUCTION 'RUN 3040'.


                * NOW READING FILES *

DO YOU WANT TO VERIFY THE FILES? YES

 1 LAYDEN,MIKE              PROF                     UNIV OF NEVADA AT RENO             804 GEAR
RENO                        NEVADA                   89503                              COSMO-928

 2 REED,DIANNE              STAFF                    BERNALILLO CTY MED CTR             2211 LOMAS NE
ALBUQUERQUE                 NEW MEXICO               87106                              *

 3 LUSK,ROBERT M.           VICE-CHAIRMAN            BRD OF COMM. COUNTY OF BERNALILLO  *
ALBUQUERQUE                 NEW MEXICO               87102                              *

PLEASE INDICATE, BY NUMBER, THE KIND OF LISTING YOU WANT
AT THIS TIME:

   1 - CONFEREES IN ALPHABETICAL ORDER

   2 - CONFEREES IN ALPHABETICAL ORDER BY ZIP WITHIN CITY, AND CITY
WITHIN STATE, BY STATE

   3 - CONFEREES IN ALPHABETICAL ORDER, BY POSITION TITLES


=============================================================================================================

                                       * * * CONFEREE LOCATOR * * *

=============================================================================================================

                                     * CONFEREES IN ALPHABETICAL ORDER *

-------------------------------------------------------------------------------------------------------------
  NAME              TITLE                  ORGANIZATION                  ADDRESS                CONFERENCE ADDRESS
-------------------------------------------------------------------------------------------------------------

LAYDEN,MIKE       PROF               UNIV OF NEVADA AT RENO            804 GEAR                    COSMO-928
                                                                       RENO, NEVADA  89503

LUSK,ROBERT M.    VICE-CHAIRMAN      BRD OF COMM. COUNTY OF BERNALILLO *                           *
                                                                       ALBUQUERQUE, NEW MEXICO  87102

REED,DIANNE       STAFF              BERNALILLO CTY MED CTR            2211 LOMAS NE               *
                                                                       ALBUQUERQUE, NEW MEXICO  87106
```

listings ran about eight feet long by the end of the conference, and the message listing ran to three pages. Also anticipate the need for a lot of standing room in front of the listings. They proved to be very popular with the conferees.

On a more positive note, the service was valued and a fee was collected which was sufficient for expenses and the generous compensation of my assistant. Since I enjoy writing these articles more than providing the service, I now offer CONFEREE to the LEMONADE COMPUTER SERVICE with the assurance that the program as revised works fine and that there is a rather substantial market which needs it.

about the program and hardware

Past articles of mine have contained packed program listings. That is to say, as many statements as possible were packed onto a single program line. This was done to save memory at the rate of five bytes per line not used. Response to these articles indicates, however, that this economy made the programs too difficult to read and understand. Furthermore, I assumed too much with respect to the reader's programming skills, and gave too few explanations of what was happening in the program. The listing set forth with this article responds to these concerns. (But keep those cards and calls coming if the listings can be further improved.)

The program is simple and straightforward; its only novelty is in marketing concept. The user will be alarmed at the time required for sorts; as the list of conferees grows longer, so does the time required for sorts. This alarm is attenuated at least to some extent by

WE'RE MOVING UP

As of October 24, 1977, Benwill Publishing's Headquarters and Editorial Office moves from the 1st floor at 167 Corey Rd. to the 2nd floor at 1050 Commonwealth Ave., Boston, MA 02215.

Moving to 1050 Commonwealth not only raises our sights, it also triples our work space. Thus expanded and uplifted, we hope to serve you better. Call us. Come up to visit. Our phone number stays the same: (617) 232-5470.

```
PLEASE INDICATE, BY NUMBER, THE KIND OF LISTING YOU WANT
AT THIS TIME:

    1 - CONFEREES IN ALPHABETICAL ORDER

    2 - CONFEREES IN ALPHABETICAL ORDER BY ZIP WITHIN CITY, AND CITY
WITHIN STATE, BY STATE

    3 - CONFEREES IN ALPHABETICAL ORDER, BY ORGANIZATION

    4 - CONFEREES IN ALPHABETICAL ORDER, BY POSITION TITLES

    5 - MESSAGES RECEIVED, BY ADDRESSEE
? 2

==================================================================================================================================

                                                       * * * CONFEREE LOCATOR * * *
==================================================================================================================================

                                          * CONFEREES BY ZIP WITHIN CITY, AND CITY WITHIN STATE *
----------------------------------------------------------------------------------------------------------------------------------
    NAME                  TITLE                    ORGANIZATION                      ADDRESS                   CONFERENCE ADDRESS
----------------------------------------------------------------------------------------------------------------------------------
NEVADA
------
LAYDEN,MIKE            PROF                     UNIV OF NEVADA AT RENO            804 GEAR                     COSMO-928
                                                                                  RENO, NEVADA  89503

NEW MEXICO
----------
LUSK,ROBERT M.         VICE-CHAIRMAN            BRD OF COMM. COUNTY OF BERNALILLO *                            *
                                                                                  ALBUQUERQUE, NEW MEXICO  87102

REED,DIANNE            STAFF                    BERNALILLO CTY MED CTR            2211 LOMAS NE                *
                                                                                  ALBUQUERQUE, NEW MEXICO  87106


PLEASE INDICATE, BY NUMBER, THE KIND OF LISTING YOU WANT
AT THIS TIME:

    1 - CONFEREES IN ALPHABETICAL ORDER

    2 - CONFEREES IN ALPHABETICAL ORDER BY ZIP WITHIN CITY, AND CITY
WITHIN STATE, BY STATE

    3 - CONFEREES IN ALPHABETICAL ORDER, BY ORGANIZATION

    4 - CONFEREES IN ALPHABETICAL ORDER, BY POSITION TITLES

    5 - MESSAGES RECEIVED, BY ADDRESSEE
? 4

==================================================================================================================================

                                                       * * * CONFEREE LOCATOR * * *
==================================================================================================================================

                                                      * CONFEREES ACCORDING TO TITLE *
----------------------------------------------------------------------------------------------------------------------------------
    NAME                  TITLE                    ORGANIZATION                      ADDRESS                   CONFERENCE ADDRESS
----------------------------------------------------------------------------------------------------------------------------------
PROF
---------
LAYDEN,MIKE            PROF                     UNIV OF NEVADA AT RENO            804 GEAR                     COSMO-928
                                                                                  RENO, NEVADA  89503

STAFF
----
REED,DIANNE            STAFF                    BERNALILLO CTY MED CTR            2211 LOMAS NE                *
                                                                                  ALBUQUERQUE, NEW MEXICO  87106

VICE-CHAIRMAN
-------------
LUSK,ROBERT M.         VICE-CHAIRMAN            BRD OF COMM. COUNTY OF BERNALILLO *                            *
                                                                                  ALBUQUERQUE, NEW MEXICO  87102
```

the "NOW SORTING" message given to the user. At least you know the micro is alive and working.

For the more adventurous, the program can be generalized. LIST headings can become input statements; the identity of fields of the DATA statements are purely arbitrary and thus can be changed, and yet the technique of consecutive sorts preserved. In fact, the consecutive sort keys can become input statements, thus governing the number and sequence of sorts.

Memory requirements for the program can be substantially reduced by the elimination of all comments and by packing the program listing. In doing so, be careful of dependencies – referenced statement numbers resulting from GOTO's and GOSUB's. Also, adjust line 10 (CLEAR) from time to time to accord with actual requirements.

The technique of shifting back and forth from CRT to printer (CONSOLE 18,0 and CONSOLE 16,0) is employed so that the printer is used only for the production of tables. The output port identified in the CONSOLE statement will have to be adjusted to the particular interpreter you are using. If you are working with a single output device eliminate all CONSOLE statements.

A word of caution seems worth repeating. Determine standards with reference to titles, abbreviations, and punctuation. In developing standards, you would be well advised to consult with the arrangements committee on every point. The program can be modified quite easily to customize the listings to the particular conference for which the service is provided. In any event, for your first conference you might add vodka to the LEMONADE COMPUTER SERVICE as a hedge against fear and frustration.

Good luck.

TOYS OR TOOLS

By Jake Roamer

Between Thanksgiving and Christmas this year, the public will be inundated in advertisements for a new breed of product, the mutant offspring of video games and personal computers. Technically skilled buyers will be curious about the ease of access to the microprocessors in these systems. With some imagination, the user may be able to squeeze more performance out of the system than the manufacturer planned.

For example, a father and son demonstrated at NCC the practicality of reaching into the Fairchild VCS to gain access to the F-8 microprocessor at the heart of the system. After a little soldering and a little programming, they had created a three-color graphic plotter and TV typewriter (with a keyboard) that performed very handsomely. In fact, for something less than three hundred dollars, they created a system that did as much as some of the three thousand dollar systems on the main exhibit floor. This isn't for the naive, non-electroniker, but for the crafty electronic hobbyist.

One barrier to finding out what's really in the systems is the consumerish, non-technical language used in its description. Software is variously called "programs," "cartridges," or even "stored bits of computer power." Peripherals are "accessories," video output the "video screen," the "playing field," or "the TV."

An item of importance to anyone dealing with graphics is the analog input to these systems. Most are equipped with what they refer to as "paddles," a holdover from the time when PONG and similar games dominated the field and the term was appropriate. Most paddles are Y axis inputs, and serve only to move something up and down on the screen. One manufacturer calls the paddle a "joystick," even though it provides only Y axis control. A true joystick provides both X and Y axis movement, allowing the user to paint a picture or graph. The Interact II is an example of the true joystick accessory.

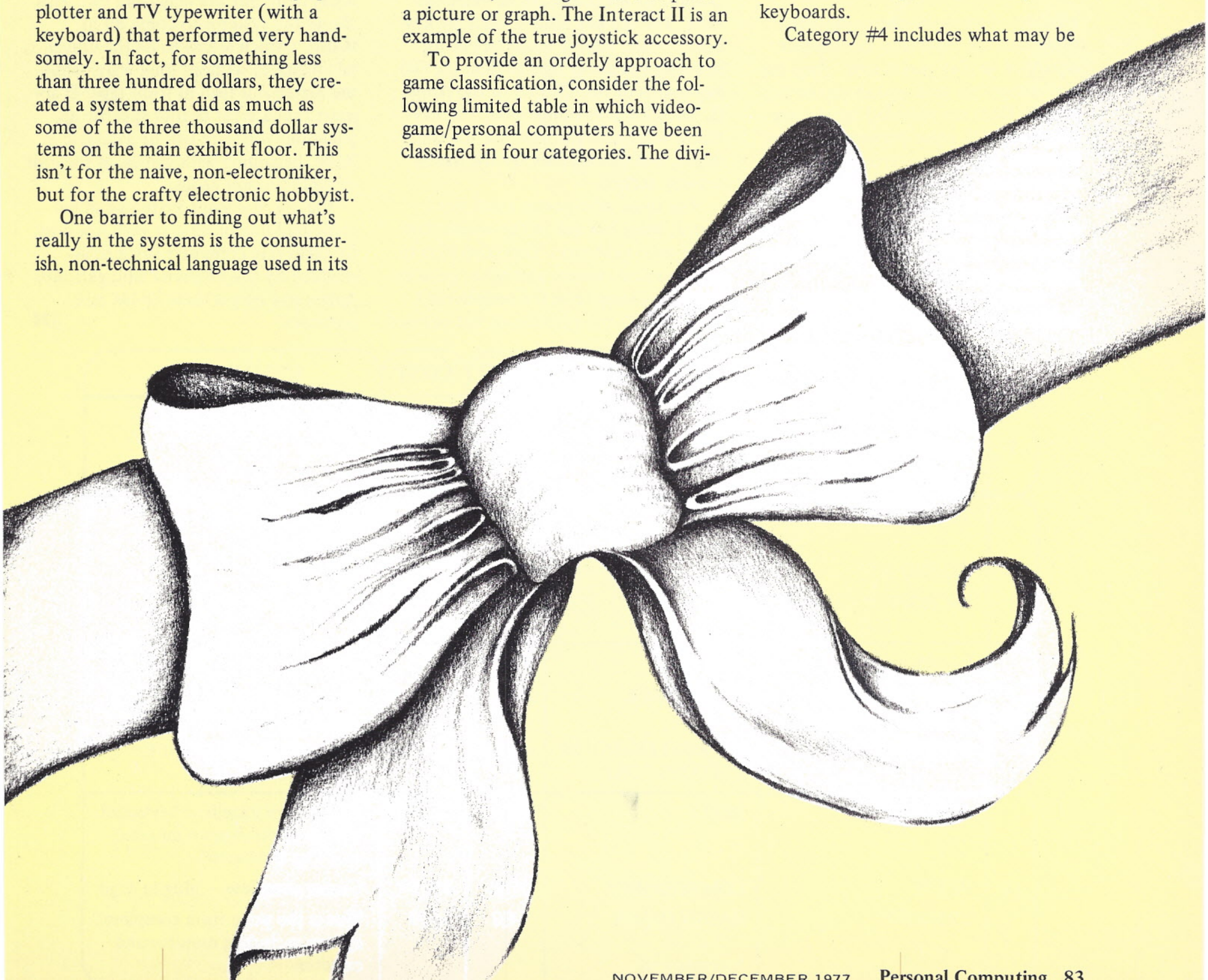
To provide an orderly approach to game classification, consider the following limited table in which videogame/personal computers have been classified in four categories. The divisions are a bit arbitrary, but useful.

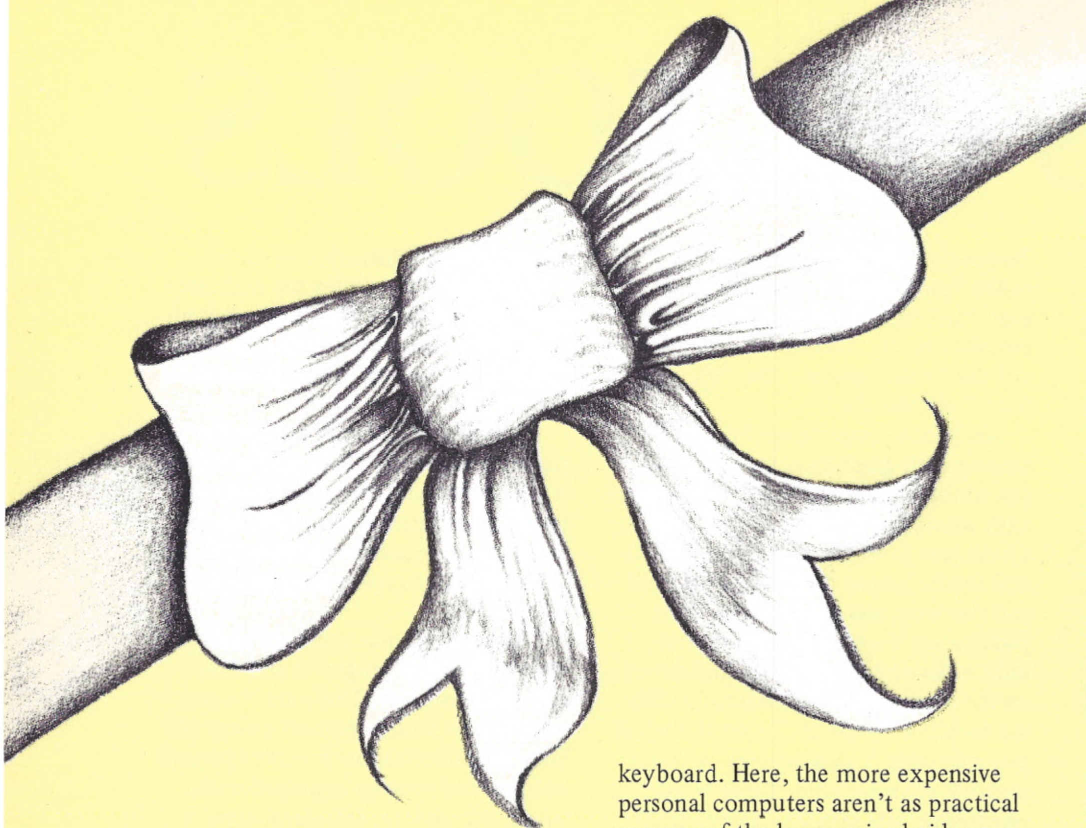
Category #1 includes the dedicated game chip systems. This is where it all started, but these are inherently non-expandable, and will be of little use to the personal computerist.

Category #2 includes ROM-programmable games. These can be turned into quite powerful systems, but only by the electronically adept. They are the cheapest systems available, and this may lead to some surprising developments.

Category #3 uses standard audio cassettes to load programs and files into the computer. These are "super" video games with computer potential. They are addressed with cartridges and paddles, and may be equipped with ten or sixteen-key, calculator-style keyboards.

Category #4 includes what may be





considered game-playing computers, those that are especially designed or equipped to play games well. They are real computers with alphanumeric keyboards. Most are provided by the manufacturer with game-playing software. Even the TRS-80, advertised as a general-purpose computer, comes with a blackjack and backgammon game package. (Will it teach me to play backgammon? I'd rather make my mistakes playing a machine!)

Besides paddles and joysticks, an important feature of the system is the keyboard. Here, the more expensive personal computers aren't as practical as some of the lower-priced video systems. The ten-key adding machine keyboard of the HLC is much better for entering a series of figures than the full keyboards of the TRS-80 or the Apple II. The PET is a strange case. The keyboard will probably frustrate the touch-typist, but this is offset by the handy ten-key section.

For those who prefer a full keyboard, Bally has one in the works, due some time next year. They also plan to add an extra cassette and other goodies (an engineering term for peripherals). In fact, with the addition of the planned $300 package, the HLC would fall into category #4 as a full-blown computer.

Research into "who is using what chip in games" has been frustrating. The chip manufacturers are reluctant to identify their customers, and the games people are dedicated to secrecy, by and large. One would like to know who is using a 6800 and an 1802 with color, but ain't nobody talking.

Software and operating systems are also important. The games people know that their systems must be demonstrated by and sold to persons with very little technical background. Therefore their systems start working when you turn them on, and the magic incantation of the computer hobbyist are unnecessary.

The manufacturers of the top machines have cleverly put much of their software in ROM. Not just the operating system, but the language, too. This allows the systems to come up in BASIC (which seems to be the universal language) without long waits while the material is read in from tape. It appears that a great deal of specific applications software will be available in ROM, beginning with games, as the cost of reproduction drops.

Clearly, the game systems can become building blocks, at very low cost, for elaborate computer systems assembled by the hobbyist who gets into games and adapts them to his own purposes.

	NAME	MFR./DIST.	MPU	COST	COMMENTS
I	PONG™ SUPER-PONG™ (SON OF PONG?)	ATARI ATARI	N/A	$44 and up	Of historical interest only
II	VCS™	ATARI	F8	$145	Easily modified by electronikers
	STUDIO II™	RCA	1802	$130	B & W only
	MICROPROCESSOR™ 1000	APF	N/A	$150	Probably T.I., MPU
III	PECOS 1016™	APF	N/A	N/A	Under wraps - PET competitor
	HOME LIBRARY COMPUTER™ (HLC)	BALLY/JS&A	Z-80	$300 - $600	Expandable to full-blown dual-cassette & keyboard @ $600
	INTERACT II™	MICROELECTRONIC SYSTEMS CORP.	8080A	$250	Color graphics next best to Apple II
IV	APPLE II™	APPLE	6502	$1300	Comes with excellent keyboard and joysticks; but no monitor or TV at this price?
	PET™	COMMODORE*	6502	$595*	Comes complete – plug in & go
	TRS-80™	RADIO SHACK	Z-80	$599	This is the price for a complete system including monitor and cassette

*price may rise

GETTING INTO GAMES

As video games expand in capability and are joined by non-video electronic games of remarkable power, the line between computers and games is beginning to blur. Can we see clearly what is happening so that we can anticipate the future accurately? Here is a big handful of information that you may be able to assemble into a distinct pattern with meaning to you.

Remember when Magnavox introduced ODYSSEY to the market a few years ago as the first full-blown, make-your-own-television-set-do-something-interesting video game on the market? The impact was enormous. . .and lasting. Video games are booming as the price drops and capability increases. Consumers are being educated to the wonders of electronic logic by these games; they are learning how to control complex systems, acquiring an increasing taste for this sort of power. Perhaps this will establish a consumer market for computers, and the matter deserves a good, hard look. In trying to develop an overview of the field, PERSONAL COMPUTING was fortunate to find Ralph Baer of Sanders Associates. . .the very man who was behind ODYSSEY, and who has remained active in the games field from its inception. In a telephone interview, he provided a crisp, practical look at the field that may be useful, as well as interesting

PERSONAL COMPUTING: You've been identified as the man who invented video games. Does that seem like a fair description?

Ralph Baer: Yes, I'm afraid it does. Most of the basic patents result from work I did and that of people who worked for me here at Sanders back in 1966-67. The patents are in our names.

Was ODYSSEY the first crack out of the barrel?

That's right. Odyssey is the name that Magnavox coined back in 1972. They stick with it as a sort of identifying brand name for the present generation of games also.

When you first began to fool with this, what did you foresee for it?

Precisely what's happened. Back in '67 I think there were some 62 or 63 million TV homes – not TV sets, TV homes – in the Untied States alone. If you latch onto 10% of that base, 6½ million homes, and attach **anything** to those TV sets. . .that's a very powerful number. In those days we talked of $29.95 TV games that could be attached to anybody's TV set, and we've just about got there. If you look at today's $20 TV games and recognize that a dollar is only about half what it was then, we're already at the $12.95 stage.

What has surprised you?

What was unforseeable, although it can't be that surprising, because we live in the middle of electronics development, is that LSI (Large Scale Integration – electronics microminiaturization) would come along as rapidly as it did. It wasn't even a gleam in our eyes, and hell, we couldn't even work with IC's in those days. There were two types of integrated circuits, both power hogs and they cost too much money. LSI technology has come along at express train speed in the last four or five years, courtesy of the calculator.

Why are the games so successful?

Everyone likes to play interactive games. I think playing games is a basic denominator. It isn't just in the U.S.; it's worldwide. There's another element, the element of remote control. You're sitting there, and across the room something is happening in response to your twiddling knobs. That's a very powerful psychological thing.

A sense of personal power?

That's right, exactly.

Are video games gradually turning into general-purpose computers?

Yes and no. One has to be very careful in the terminology. There's an intermediate situation.

These products play, in the main, familiar arcade games. They play them very lavishly, in color, doing things that last year's games couldn't begin to do . . .and besides, they're programmable. Plug in another cassette and fill in another game or group of games. How far is it from a machine of that type plus a TV set to a computer terminal? The major thing that's missing is good alphanumeric capability. Being able to put a lot of text up there and edit it; that's what characterizes a good TV terminal. Secondly, and most importantly, you need to be able to access the thing with some higher level language like BASIC, so you can actually do programming. The "computer terminal" means you talk in computer language . . .and it talks to you. Thereby hangs a tale, because present game machines simply use some preformatted memory. It really isn't a computer terminal, because it doesn't involve you, sitting there at the terminal, developing a program. The home TV terminal is basically a game machine. It may look like a computer terminal, but it isn't. It's mainly meant for games or quiz programs or education, all those things in which you do not need to generate programs of your own. That appeals to anybody. The home TV terminal doesn't have the capability of the systems now being put out by Tandy, Commodore, Heath, and the others. It's a different market. . .and in that area there's Texas Instruments in the background. . .very actively working without saying a thing.

You think TI will appear with a bubble memory system built into a computer?

You bet your life. I think they're going to give everybody a run for their money. I'd be very much concerned about TI if I were in the personal computing/home computing business, which I'm not, thank goodness.

Are you in that intermediate area of which you spoke? There must be a big market for elaborate prepackaged programs in which the user just responds with data to questions that are asked.

Well, this is the area of machine-aided-education or whatever you want to call it. It's been around for a long time in many different formats – on video tapes, audio tape, interactive, noninteractive – and guess what. Nobody has made a bloody nickel in this business, because the education market is extremely fragmented. You can't get educators in schools to cooperate with one another. What one school develops, another won't use, etc. . .

Yes, but what about home applications in which the user just puts in data for the computer to manipulate in some useful way?

Certainly, if you have a recipe and you're having people over to dinner, you ought to be able to punch some buttons and have the damn thing spit out the quantities you're supposed to mix up. You can practically do that with a calculator.

But the calculator doesn't ask you all the leading questions.

Right. In fact, you really want a

voice over, asking aloud if you have finished mixing the butter with the batter. Whatever. Maybe this will happen. Some of these things sound great and clear, but when you come right down to them, they're not. They are very much software dependent. You really have to create good scenarios.

One thing that's always in back of us is commercial TV, which spoils us totally in the sense that it makes us expect professional pictures and very professional performances. The product must be polished – and that means it has to be prepared, and it's expensive.

Do you feel so negative about people designing games with their own systems?

No, I'll tell you what's going to happen. . .what's already happening. Where does most of the software come from? It comes from guys playing around at home on their own systems or playing after hours on the company system at the office. Young guys in school, college especially, are responsible for creating half the computer languages we have and half the techniques. . .and not because they had a formal job to do or got paid by the hour. As personal computers do invade the home for one reason or another, I think the schools will begin to wake up little by little to the fact that the student should be able to speak one or two computer languages by the age of 18, those who are interested. We're developing a whole new generation of kids who won't be afraid to generate software.

"Games are the common denominator that will suck people in . . . to becoming familiar with the big keyboard."

Are you going to be recruiting employees soon from the kids who are learning technology from games today?

It could be. It's all synergistic. The home computer market will not really blossom until there is a large number of people out there who are not afraid to step up to a terminal, sit down, and actually do some programming. You know, second nature to them.

Will games lead people into this?

Yes, games are the common demoninator that will suck people in, so to speak, to becoming familiar with that big keyboard. Now that we have them used to a four-function calculator keyboard, the next thing will be the alphanumeric keyboard. Once we get them to playing games, answering questions, and getting answers, they'll say "why can't this stupid thing do this or that?" The answer to that question is: "If you will get off your fanny and learn the computer language, and buy the proper terminal, it'll do those things and more."

What new developments do you see in the near future?

What's next year? More of the same, only better. Every year we seem to move another generation ahead. There's a whole world full of talent being applied to this area. I look ahead three or four years to the relationship between such things as video tape, which is coming in pretty strong. . .the Betamax situation. . .and video discs. We ask every six months, as technology moves on, what is the role of the video tape recorder as a playback machine in connection with playing games. The role is obvious in terms of education, especially in the case of the Phillips video disc with random access capability that allows branching and all sorts of neat things, but what's the role of TV tape playback machines that can do nothing efficiently except roll on, glide on in one direction? We've come up with some realistic answers to this and are in the middle of a program now that I can't talk about. It will demonstrate some interesting ideas when we're ready.

Is it your personal assignment to work three or four years ahead of the current market?

Yes, easily that. I've been ranting and raving for ten years about the use of games on cable TV. The very first person we showed the concept to was Irving Kahn of Teleprompter, years ago. We were just ten years too soon. Right now I see people monkeying around with two-way cable systems, and it seems to me this is the wrong approach, because there are twelve million homes wired up on one-way cable. Well, that's what I want to tie myself up to, not some little system in Ohio that has fifteen hundred subscribers. I'm working in that area.

Nobody is going to originate anything locally in cable; they'll plug in a cassette or disc or whatever, maybe break in with the local Uncle Henry to add local flavor. Beyond that everything will be canned. What's the difference between palying a game on cable and playing it on a system at home? The only difference is the length of the cable; your home system may use a cable five feet long, and the cable TV system may use one five miles long.

Are the exciting technical developments in prospect?

Yes, in the memory area. Everything is memory dependent. Memory is the key to everything, and here's bubble coming along fast. . .who knows what else? Even if there are no big surprises, there should be even more rapid decrease in cost, so that one can do really complex things with very little money.

Is anything in this field particualrly annoying to you?

Yes. The manufacturers have been screaming for years that TV manufacturers should put a jack in behind the sets so you can get into the video portion without going through the antenna terminal.

You want to work around the FCC.

Of course. It's stupid to broadcast something when all you need is a twenty-five cent jack to do things right. Actually, things are coming along very well, so I can't be too irritated.

You mentioned non-TV games.

I've got an outfit consulting to toy and game manufacturers through Marvin Glass and Associates. There's a lot of business out there in non-TV electronic games. Parker Bros, Mattel, and Milton Bradley are the first wave with their new games. That's just the beginning.

Aren't they going to need some new, cheap display technology other than television?

Yes. That's what's holding them back. What can you do for a few dollars or even pennies. Not much today.

That's a new field of development.

Yes.

Sanders Associates is hardly an entertainment company.

No, the work I've been doing is completely unrelated to the primary defense business of the company.

But they must be happy enough with the income from your work.

We've collected seven figures here, bottom line capital gains money.

And you see more coming?

Oh yes.

Thanks.

While this discussion does not render the technology, history, and future of video games crystal clear, it suggests that the great stir of activity in the field is not trivial, and that the impact on personal computing may be large. Well worth watching.

With video games looking more and more like home computers, and with home computers playing more and more games, putting these devices into neat little categories becomes a near-impossible task. To give you an idea of where the frontiers overlap, we discuss four video game playing machines in detail: INTERACT, the GI chip set, the Apple II home computer and the Home Library Computer.

Do It Yourself

HICKSVILLE, NY – By the third quarter of 1978, General Instrument plans to make available a complex LSI chip set enabling TV home game enthusiasts to design their own arcade-quality games.

According to microprocessor manager Ron Stephens, the games will have the capability to be programmed at a level of complexity that will rival that of any game now implemented or under discussion in the industry. The most complex game so far revealed to the public is Ralph Baer's "Sunday Night Football," which has players running, blocking, and tackling each other under NFL rules (See *Electronic Engineering Times,* August 8, 1977,

The GI chip set will enable high-speed motion, under microprocessor control, of eight separate foreground images (e.g., football players) in independent directions and speeds, plus an assortment of more slowly moving background characters that can optionally be used for extra objects or players. To implement the user-designed games, a keyboard, cassette, BASIC programming language and an additional graphic subset of BASIC will be used.

"The game creator," says microprocessor engineering manager Duncan Harrower, "will be able to create, say, a shooting game by moving a cursor to any location desired, calling forth from a library of images a plane and an anti-aircraft burst, and then specifying how close the burst comes for a hit and the consequences of that hit. The final game will then be transferred from the game memory to cassette audio tape for storage and replay."

The preprogrammed game box will be the fourth and most complex chip set to be offered by General Instrument. Each of the sets will be based on the GI model 1610 16-bit microprocessor, a single 8900 STIC (Standard Television Interface Circuit), a 16K to 20K graphics PROM containing assorted pre-programmed foreground and background images, a sound synthesizer and A/D converter IC, a controller and I/O interface chip and ROM memory.

Graphic Language

After the first three products, the user-programmed set will appear with additional graphic language necessary for game generation added in ROM to the BASIC language set. It will also have the ability to store such games on cassette.

The STIC generates TV raster timing, moves background and foreground images called by the processor from the graphics PROM, and programs the consequences of intersections or collisions between images. The background can be slowly rolled left-right or up-down, used as conventional alphanumeric display for the home computer, or can appear in the form of moving squares in different colors. The foreground images can be moved independently on receipt of new coordinates from the microprocessor.

Pure Applications

One of the more flexible video games now on the market is INTERACT, produced by Microelectronic Systems Corporation, Madison Heights, Michigan. Games (and educational programs) are read into the system from pre-packaged tapes for display on a color television set. The conventional game paddles and a 16-function keyboard allow the player to interact with the system in much more complex fashion than is allowed by the joystick alone. In fact, the system is equipped with 8K bytes of memory and the manufacturer's literature refers to INTERACT as "The Personal Computer."

Not surprisingly, INTERACT is in the process of evolution, and is expected to be on the market in its third generation by late 1978. As a full-blown computer system competing with PET? No, that's the surprise. Dr. Ben Berman of MSC explains that INTERACT is being designed entirely for the consumer as an applications-only appliance. While the developed system will have a full alphanumeric keyboard and the ability to work with more peripherals, INTERACT is for users, not programmers. The company plans to offer a large library of packaged programs for applications in sales, inventory, tax calculation, education. . . and anything else that seems practical. The user need only plug in a tape for the application he has in mind, and respond to the system's prompting with data and instructions. No BASIC, no jargon, no monkey business with technology, just applications.

It may seem a shame not to provide programmer access to the system, but consider what effect this decision has on cost. The third generation INTERACT is planned to sell at retail for something between $250 and $300, with programs selling for $6 to $20. Of course the user is dependent on the company to make the machine useful; no program, no action, but if the library appears on schedule, this elaboration of video games may become important in the market.

The Apple is Rolling

Video game manufactureres are producing equipment with astonishing computer capability, but keeping the information fairly quiet to avoid scaring off consumers who are intimidated by the very word "computer." However, at least one real computer company has made a move in the other direction.

The Apple II, produced by Apple Computer, Inc., has been portrayed largely as a game-playing machine. In fact, the Apple II is an elegant 6502-based computer with a built-in cassette interface, a video driver, a nice

6K BASIC in ROM (like Ohio Scientific, PET, and Radio Shack systems that have been announced) and a system monitor in 2K of ROM with important features for the computerist like a floating-point package and disassembler. Both RAM and ROM in this system can be expanded from the minimum configuration by plugging chips into sockets already provided – no need to buy whole circuit cards for the purpose. The manufacturer assures customers that all of the standard (and some unusual) expansion cards and peripherals are on the way. This is to be a complete computer system.

What's novel?

The emphasis is novel. Apple has gone to uncommon lengths to give this system the kind of audiovisual excitement that so charms consumers with video games. Surely, the appeal of video games arises from the sense of power the user gets from *making something overt happen.* The Apple is equipped with remarkable color video control that lets the user display splashy effects. The biorhythm demonstration program with Apple II not only plots the curves in color, a built-in speaker makes entertaining sounds as the tick marks are placed on the screen. That speaker beeps and burbles during many of Apple's operations, to add both information and entertainment to the activity. When the computer is thinking, and the user begins to wonder if it hasn't fallen asleep, Apple II gives signs of life, displaying color patterns on the screen, and piping up with little audio fantasies.

The Apple II comes to the buyer with two "game paddles" as standard equipment, allowing users to play Breakout and PONG as they might play with any video game. (Users will be startled to realize that routines set up in the system allow an on-screen display of a value between 0 and 255 that represents the position of the lever on the game paddle. That is, the paddle can be replaced by some instrument – a thermometer, pressure gauge, whatever – that can report directly to the computer through this channel for control applications. Meanwhile, that's a *game* paddle.) Even the computer cabinet (a very clean molded plastic case with a keyboard) looks more like a game controller than a computer.

And Coming In From Left Field

The personal computing business has been almost as smug in its behavior as the professional computing business from which it sprang. It's so easy to slip off into the comfortable jargon of this little specialty, that insiders forget or ignore the billions of people in the world who may be mildly curious about computing, but are put off by the obscure language. Yes, PERSONAL COMPUTING tries to be the understandable magazine, but concise clarity is an elusive target even when one knows a little something about the subject. Given this, consider a remarkable advertisement that appeared in the Wall Street Journal on July 26th, 1977.

In about three thousand words, the ad discusses features of a new product, the Home Library Computer, made by Bally, "the world's largest manufacturer of coin-operated amusement games." The advertiser was JS&A National Sales Group (of Northbrook, Illinois, 60062), a very familiar mail-order merchandising firm. Not only is the product interesting, but the ad itself is a fascinating exercise. In it, a fellow who really doesn't know anything about computers is trying to explain a computer system to potential customers who also don't know, and presumably don't care, about

the technical peculiarities of computers. The product is treated chiefly as a video game. The discussion is puzzling to the computer buff, as it must be to the complete novice, but the usefulness of the system is fairly clear. Items of interest:

The system is small, 5" by 11" by 13", and looks very much like other programmable video game systems (the Fairchild, for example) with a slot for plugging in a tape cartridge and a number of pushbutton controls, including a small calculator keyboard.

The system is referred to as a "printing calculator" in which the printing appears not on paper tape, but on the face of a television screen. This is an "electronic calculator with ten memories" . . . "whose computing power resembles that of the IBM 5100 currently selling for $10,000." (Um . . . unh . . . yes, the 5100 sells for about that price, including a nice CRT display and a rather classy tape recorder, along with sophisticated software . . . but, sure, this system could have the "computing power" of the 5100 . . .) It now has an internal library of over 40 tasks. (Can this be software in ROM?) Four game control "paddles" are supplied as standard equipment, along with a whole raft of elaborate video games and some educational programs.

The system is based on the Z-80 microprocessor, and comes with "12,000 bytes of computer power." (Could this be RAM?) Memory is apparently expandable. The ad speaks of "8000 bytes in its cartridges." Apparently that's the minimum number and there is some talk of cartridges that will handle a quarter of a million bytes – conventional cassette capacity.

Many add-ons are planned so that it can grow into a complete computer system for the home . . . and the ad refers to this as "the affordable consumer computer," sharply differentiating consumers from hobbyists, a sensible distinction if ever there was one.

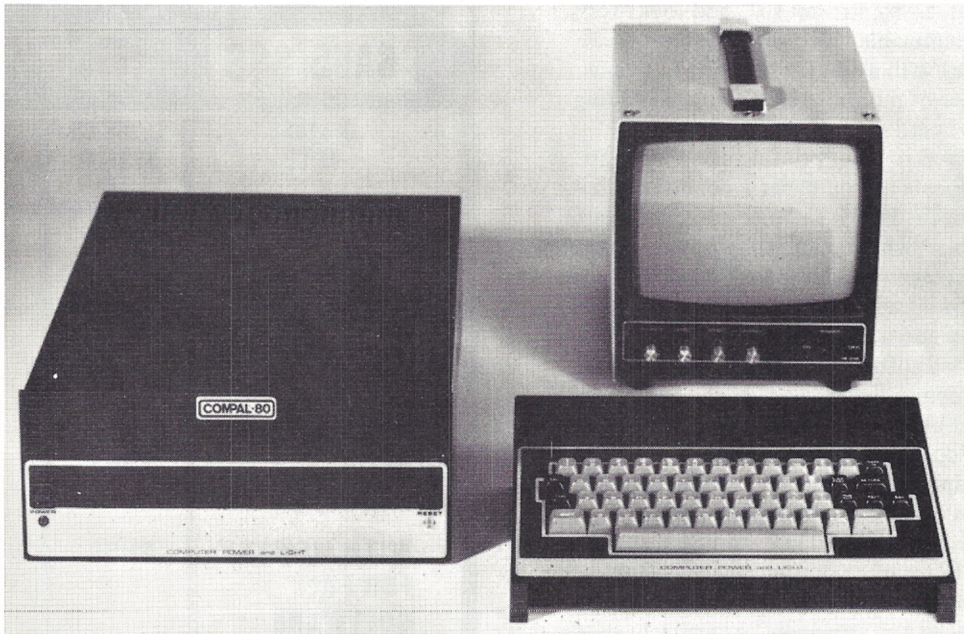
The "most significant" expansion accessory will be "the $300 dual magnetic tape decks with alphanumeric (typewriter) keyboard." Apparently, this accessory, due in "six months," is to include another 16K of expansion memory. Wow.

The basic system sells (with four pistol-grip game-control paddles) for $299.95, shipping included. With the keyboard/dual cassette and extra memory for $300, this whole system is in the same ballpark as the PET or the Radio Shack systems that have received a great deal of publicity.

You really have to talk to Bally to find out what the details are, because JS&A doesn't know. Bally, on the other hand, isn't even making an issue of the full computer characteristics of this Z-80 system. In their sales apart from those through JS&A, they are billing the thing as a video game, an "arcade game," not even mentioning the computing features. Why would they? Who knows or cares about computing?

If Bally and JS&A were garage operators, one might chuckle at all this naive talk and turn back to serious matters. But they're not garage operators, they're good, solid companies with good reputations and a lot to lose. Unlike almost anybody else in the field, they are addressing a consumer market in consumer terms. Perhaps it is significant that when PERSONAL COMPUTING phoned JS&A to discuss this in mid-August, worried that the ad clipping hadn't come in until almost three weeks after publication, it turned out that no other magazine in the computer field had yet contacted them. They were surprised, and so were we. PC

SEE THE LIGHT



The COMPAL-80 computer system: **$2300.00**

WHAT YOU SEE IS WHAT YOU GET!
The computer, with 16K memory, input/output ports, keyboard, 9'' video monitor, all enclosures, and powerful extended BASIC language — Just plug it in and you're ready to go!

WE'RE READY NOW.
The COMPAL-80 is a complete, fully-assembled guaranteed computer that is available now. Put it to work for you on home budgets, checkbook balancing, investment profiles, mailing lists, record/book/recipe indexes, text editing, mathematical/logical skill development, word games, strategy games, sports simulations, and more . . . We have ready-made programs available,

or if you'd rather,
WE'LL SHOW YOU HOW
to write your own programs!
Anyone can write and speak eloquently in computer language after attending our series of classes which deal directly and efficiently with the art of programming.

THE COMPAL-80 IS FULLY EXPANDABLE.
You can easily increase the power of the COMPAL-80 computer, by adding more memory, a printer, plotter, dual floppy disk drive, etc. . . .
Inquire about our business systems with dual floppy disk and printer, in a fully-coordinated system including disk BASIC and a variety of business software packages.

COMPUTER™
POWER & LIGHT INC.

12321 Ventura Blvd., Studio City, CA 91604 (West of Laurel Canyon) 213 760-0405

7878 Clairemont Mesa Blvd., San Diego CA. 92111 / (714) 565-2041 • 12321 Ventura Blvd., Studio City, CA. 91604 / (213) 760-0405

Bank financing arranged. Also Credit Cards and Cash.

CIRCLE 26

A STONE-AGE LUNAR LANDER

by Paul M. Jessop

Next to 'Star-Trek' (variously known as 'Galaxy', 'Klingon Capture' and 'Space War'),the most popular computer game must be 'Lunar Lander,' where the player has to land a rocket on the surface of the moon or some other stellar body.

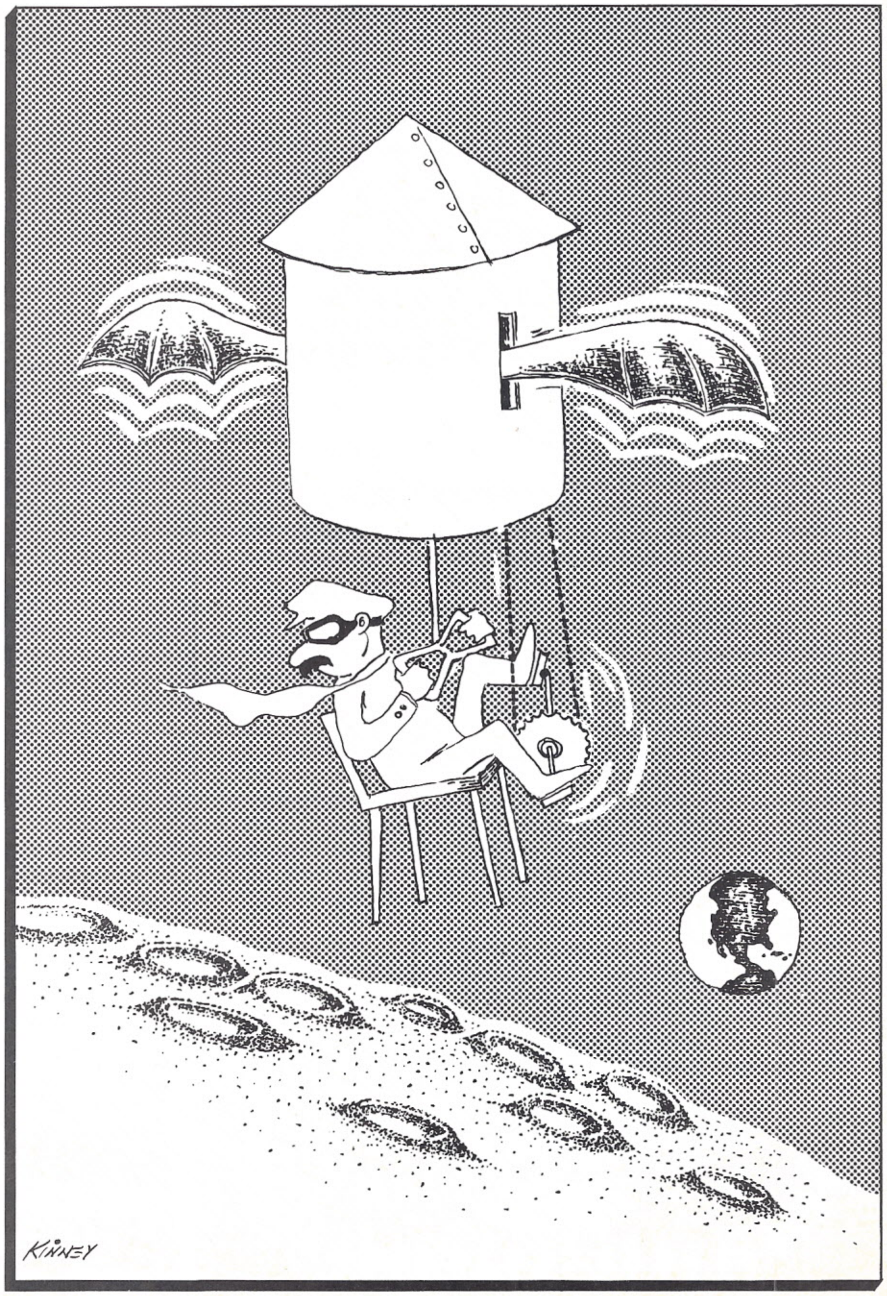
Most of the versions are written in BASIC and give the player the opportunity to define the time interval between updates, and at each update, define the amount of thrust used. At each update, the computer prints the height, the current velocity and the amount of fuel remaining. Some of the programs also take horizontal distance into account and allow the user to alter the attitude of the craft. All very clever.

But what of the user of a system which has for peripherals only a switch register and a row of LED's? Surely a valid simulation can be contrived for such a system, just as well as for the more powerful one. Indeed, what the system lacks, the player must make up for in skill. A program has been written for the KIM-1 which uses the built-in hex keyboard to regulate the thrust and displays the height, velocity and optionally, fuel remaining on the on-board 7 segment/LED's. But an even more basic system than this can still be used to provide an enjoyable game.

Consider the case of the pilot of a LEM (Lunar Excursion Module) who has suffered failure of all his on-board computers (and of course he cannot link up to one on earth because the delay in sending the signals and receiving the reply is intolerable, not to mention the fact that the communications equipment was controlled by the computer!). The only control at his disposal is the valve determining the flow of propellants to the engine. Because of the computer failure, all the fuel gauges are down, but the tanks are known to be full. All the pilot knows is that he has x seconds of burn time to put his LEM safely on the surface of the moon and await rescue by a party from the nearest moon-base, which is tracking him on radar.

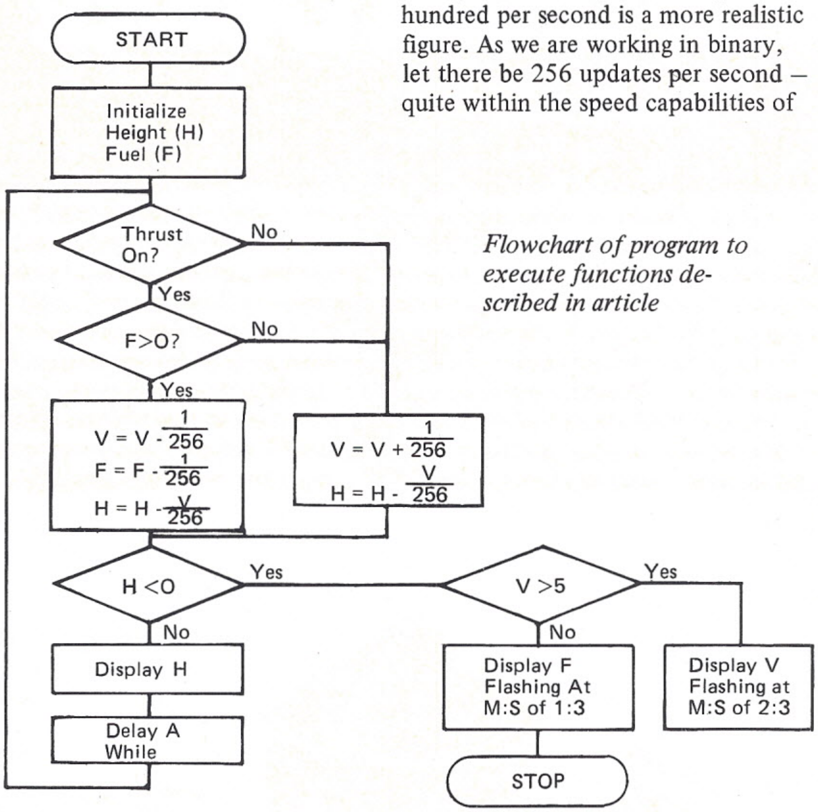
How can this be simulated on a small computer? Well, the pilot can estimate his altitude by looking out of a window, so let one 8 bit output port feed 8 LED's to display the altitude in binary. The velocity can be seen by the rate at which the display counts down, and the acceleration will not concern the pilot as it is dependent solely upon the gravitational field of the moon and the thrust which are both constant anyway. So the poor pilot knows where he is.

As for thrust, a single input line can be connected to a switch, either a morse key or a foot switch. Now gravity on the moon is equal to 1.6 m/s^2, call it 1 m/s^2, and make the thrust cause an upward acceleration of 2m/s^2, giving



Paul M. Jessop lives in Solihull, West Midlands, England and has absolutely nothing to do with NASA Mission Control.

a net upward acceleration of $1 m/s^2$. This all helps the arithmetic. So, every second, the velocity will increase (or decrease, depending on whether the motor is on) by 1m/s. Also, every second, the distance will decrease by the amount of the velocity (or increase if the pilot happens to want to go up!). However, an update every second is totally insufficient, and a couple of hundred per second is a more realistic figure. As we are working in binary, let there be 256 updates per second – quite within the speed capabilities of any processor. Thus, every 1/256 second, add or subtract 1/256 m/s to/from the velocity and subtract 1/256 of the velocity from the altitude.



Flowchart of program to execute functions described in article

A counter is also required to keep track of the fuel remaining. On running out of fuel, the program should merely prevent the player from burning any more fuel, and allow the craft to coast to its doom. On impact, the display should show the impact velocity, flashing, to indicate that the display is no longer altitude. On landing with a reasonable impact velocity, the display should show the fuel remaining. Again it should flash, but with a different mark: space ratio to distinguish between the fuel and impact velocity.

A flow chart for a program performing these functions is shown at left. Clearly, as the processor works in binary, the initial parameters should be set to convenient values, e.g., the height should be initialized to 65536 (2^{16}) to enable the height to be stored in two 8 bit storage locations. Only the most significant 8 bits should be displayed.

It is hoped that these notes will provide a spring-board whence others may create customized versions of this popular program for their own personal computers whatever their size.

Meet your company's newest idea man.

Technotec connects your phone to a source of over 15,000 breakthrough ideas.

OPPORTUNITIES YOU WON'T FIND ELSEWHERE

What is Technotec? It's a new service from the Control Data Corporation that serves you like a "global want ad system". Over 15,000 descriptions of things people want to buy or sell have been put into Technotec's data banks in little more than a year. It's the type information usually *not* available from conventional sources because it's from worldwide users in virtually every business discipline and profession.

Included are buy and sell offers on products, processes, services, literature, technical concepts, patents, business opportunities, etc.

WORLDWIDE COMPUTER NETWORK

The data is stored and retrieved through a $1 billion world-wide computer network. But don't get the idea it's for computer users only. Anyone can use it. Profitably.

ANYONE CAN USE TECHNOTEC

By completing a simple form, any company can describe any patent, product or business opportunity. A consultant can offer expertise for sale the same way. So can a company *seeking* expertise, a product, patent, etc. — just as they would to run a want-ad in a local newspaper. Instead of printing and laboriously distributing the information for a brief exposure, Technotec puts it into rapidly expanding data banks that can be read by worldwide users for a year!

INCREDIBLY ECONOMICAL

The charge for putting information into the data banks is based on length of the message. For 1000 characters (about 125 words) the cost is only $100 for a year of worldwide exposure. That's less than many local newspapers charge for one day!

To "read" the system *directly* all you need is a TWX, Telex or computer terminal coupled to your telephone. If you don't have a terminal,for a small surcharge we search and report results for you by mail or telephone.

Searchers pay a modest, one-time subscription fee and thereafter, only for computer time used — typically $8-10 per search. Technotec does not charge brokerage fees nor royalties.You deal directly with the party the system identifies as one you want to contact. There are no other costs unless the latter has specified one (to qualify his inquiries) and you agree.

Sample Technotec Entries

(these are just a few examples of over 15,000 entries in Technotec's worldwide system)

A method of retrieving data from a data source by use of finger touch sensitive pads on the faceplate of a CRT display.

Comprehensive computerized literature searching available from NASA's Industrial Applications Centers.

Data input keyboard terminal with exclusive offline instantaneous checking floppy disc memory and deferred transmission of data.

Computerized printing and reproduction.

Computer hardware spatial transforms for computer graphics.

Automatic dialing of telephone numbers using punched cards, magnetic track cards, or a rotating drum.

Communication system for transmitting and receiving digital phase modulated information.

Braille-oriented terminal.

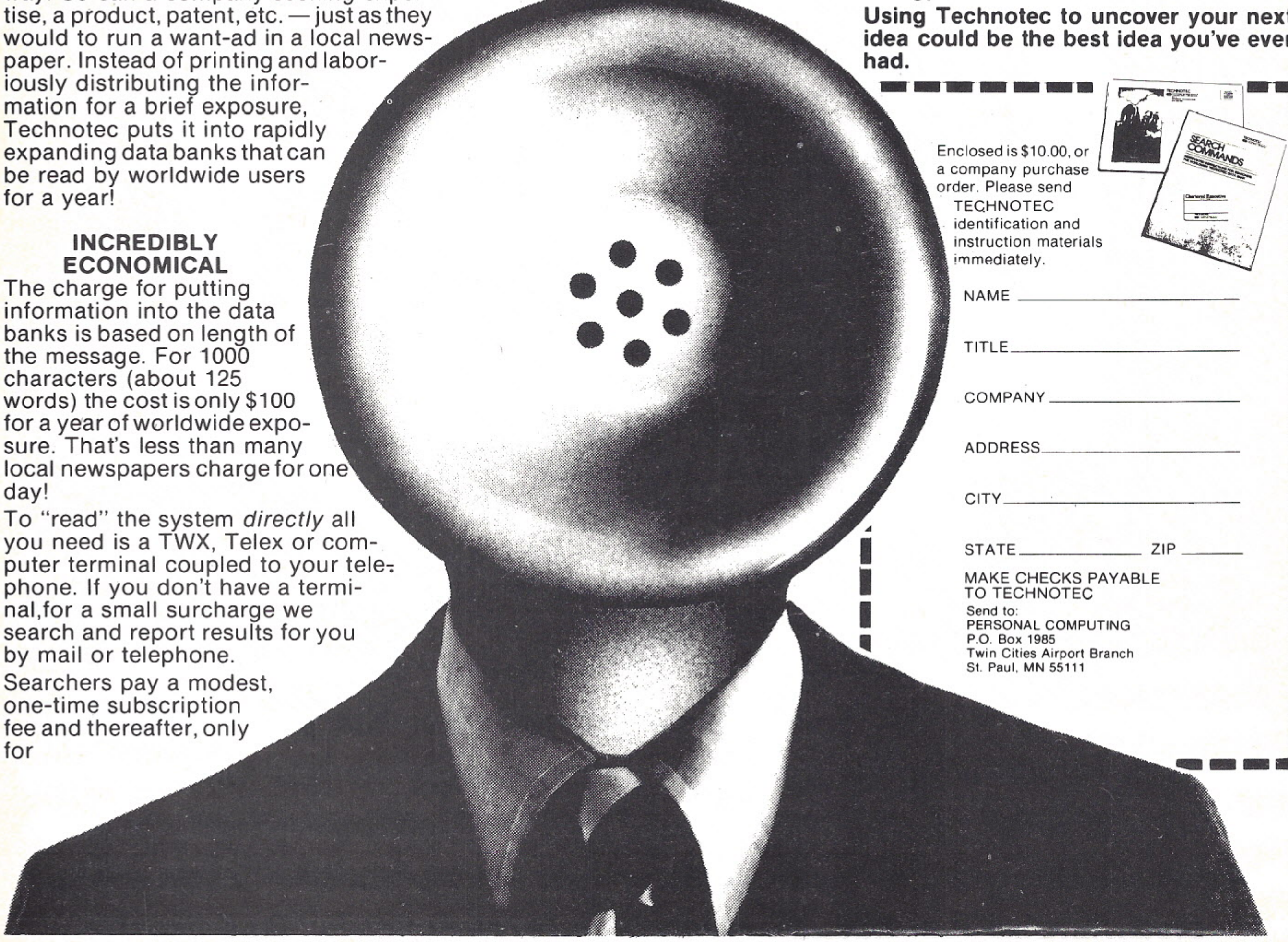
Digital to analog converter.

Special introductory offer

As a special introductory offer, we're offering everything you need to search this worldwide system for only $10.00. Here's what you get:

- **SEARCH CARD** — your exclusive identification words, code number and computer commands for the system ... you can also use it to obtain service at over 100 Control Data public service centers, or directly from our headquarters by hotline, telephone or mail.
- **USERS' MANUAL** — instructions for entering information in the data bank and searching it . . . these are simple procedures for the layman ... it also includes sample searches, local telephone numbers in 120 cities, public terminal locations, pricing structure, etc.
- **TECHNOLOGY UTILIZATION NEWS** — this periodical keeps you up-to-date on ways to get the most value from Technotec; major additions to the data bank and news of interest to anyone involved in marketing, R & D and technology transfer.

Using Technotec to uncover your next idea could be the best idea you've ever had.



Enclosed is $10.00, or a company purchase order. Please send TECHNOTEC identification and instruction materials immediately.

NAME ______________

TITLE ______________

COMPANY ______________

ADDRESS ______________

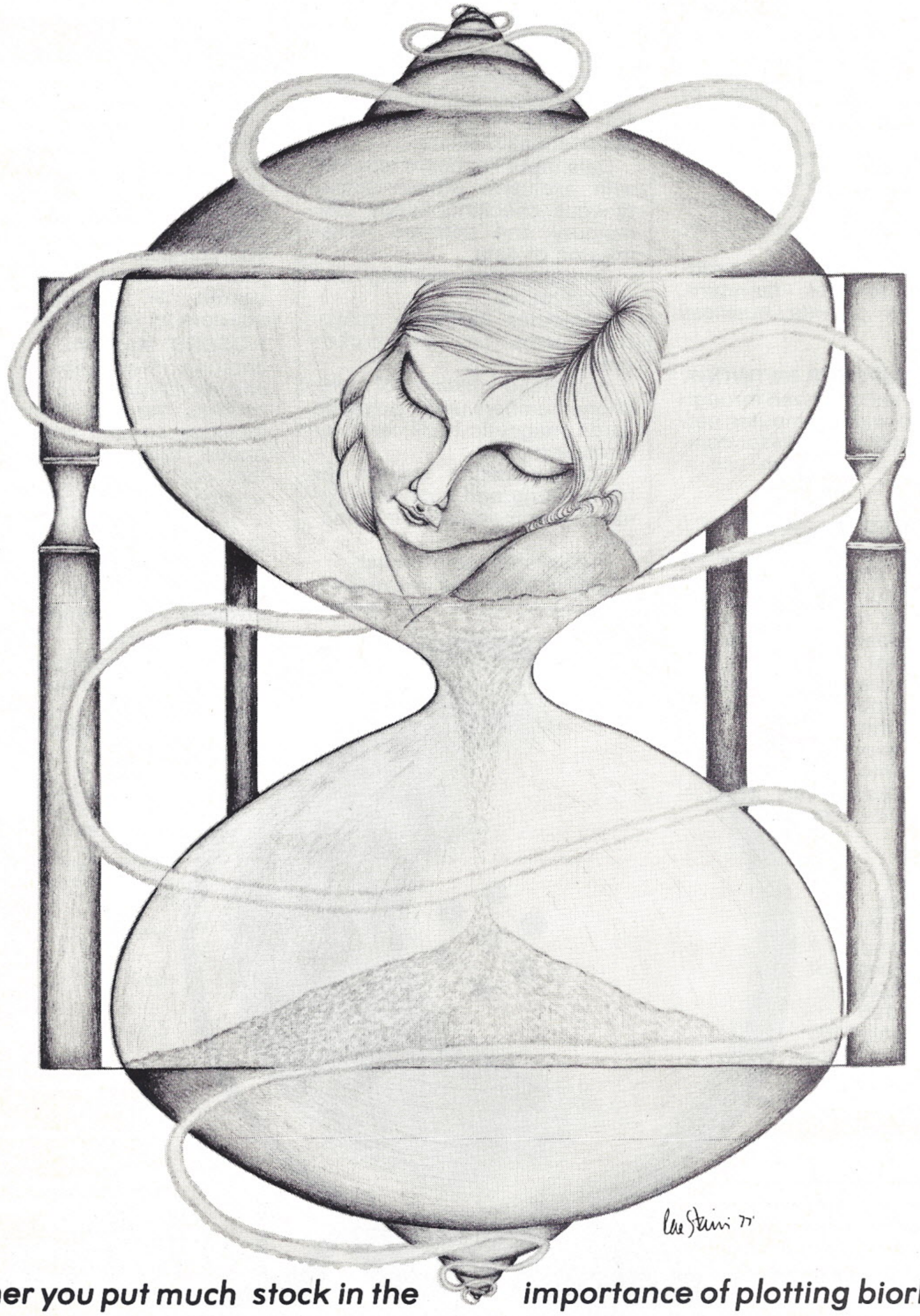
CITY ______________

STATE ________ ZIP ______

MAKE CHECKS PAYABLE TO TECHNOTEC

Send to:
PERSONAL COMPUTING
P.O. Box 1985
Twin Cities Airport Branch
St. Paul, MN 55111

biorhythm



Whether you put much stock in the importance of plotting biorhythm charts or not, the exercise is very attractive for people with personal computers, because the computer can chew on so many nice numbers in such a systematic way and then display the results so neatly that everybody feels satisfied with the work. Many biorhythm programs are available, and the literature is full of discussions of the subject. Here's a neat, tidy little program and explanation for experimentation.

& readout

by Phil Hughes

Biorhythm Execution

```
ENTER NAME? JOSEPH PROGRAMMER
M FOR MONTH OR Y FOR YEAR? M
BIRTH MO,DA,YR? 1 ,2 ,1934
ENTER START MONTH, YEAR? 7 ,0


BIOCHART  --  JOSEPH PROGRAMMER
BIRTHDATE  --  2 JAN 1934

C=COGNITIVE
P=PHYSICAL
S=SENSITIVITY
```

```
BIOCHART FOR JUL 1977
    JOSEPH PROGRAMMER
         (-)                     (+)

JUL 1    P             I        C  S
JUL 2   P              I      C S
JUL 3   P              I   C  S
JUL 4     P            IC S
JUL 5       P         CS
JUL 6          P   CS  I
JUL 7           *  P   I
JUL 8         *        P
JUL 9      SC          I   P
JUL 10   SC            I       P
JUL 11  SC             I          P
JUL 12  *              I            P
JUL 13  *              I              P
JUL 14  CS             I              P
JUL 15   C S           I             P
JUL 16     C  S        I           P
JUL 17       C  S      I        P
JUL 18         C    S  I     P
JUL 19           C     S P
JUL 20              CP I  S
JUL 21           P     C      S
JUL 22        P        I  C     S
JUL 23     P           I     C     S
JUL 24   P             I       C     S
JUL 25  P              I         C    S
JUL 26  P              I           C  S
JUL 27    P            I             CS
JUL 28      P          I             SC
JUL 29         P       I           S  C
JUL 30             P   I        S     C
JUL 31                 P      S      C
```

Biorhythms, and the theory of their charting, rest on the premise that three cycles, beginning on the day of birth, affect you throughout your life. Each of the three cycles has its own period; the Physical lasts 23 days, the Sensitivity or emotional cycle lasts for 28 days and the Cognitive or intellectual cycle lasts 33 days.

The Positive Discharge and Negative Recharge Periods

The cycles rise and fall across a center line, representing a division between the expenditure of energy, resting and the gathering of energy. We will designate the energetic, active side of the division as the "+" side, and the side of rest and rejuvenation as "–".

Critical Days

Critical days occur when any cycle crosses the division from "+" to "–", or vice versa. During this time, you are more likely to feel unsure and indecisive about the things that the particular cycle deals with (i.e., clumsiness when the physical cycle crosses, indecisiveness during cognitive crossings, emotional difficulty while sensitivity crosses.)

Cycle Ups and Downs

Particular characteristics appear with each cycle. When the physical cycle enters the "+" days, your feelings of physical well-being increase. During "–" days, however, you may suffer a lack of get-up-and-go. The cognitive cycle governs decision making and intellect, and on high or "+" days, you may have little difficulty making a decision that would pose a real problem on low days. The sensitivity cycle indicates feelings of emotional well-being and preparedness. On low days, accidents seem to occur more, according to Japanese studies.

Individual Adjustments

On all of these cycles some adjustment must be made for individual differences. An even tempered person may see little change between high and low days of the Sensitivity cycle, though an emotional person may feel as if she/he is on an emotional roller-coaster. A sedentary person might

not feel the difference on the Physical cycle that an athlete would.

Further, more detailed information on biorhythm theory can be obtained in books such as "Biorhythms In Your Life," by Daniel Cohen.

Chart Your Own Biorhythm

A program to calculate biorhythms falls logically into two parts. The first part finds the number of days which have elapsed from your date of birth until the start of the month and year desired for the chart. The second part of the program

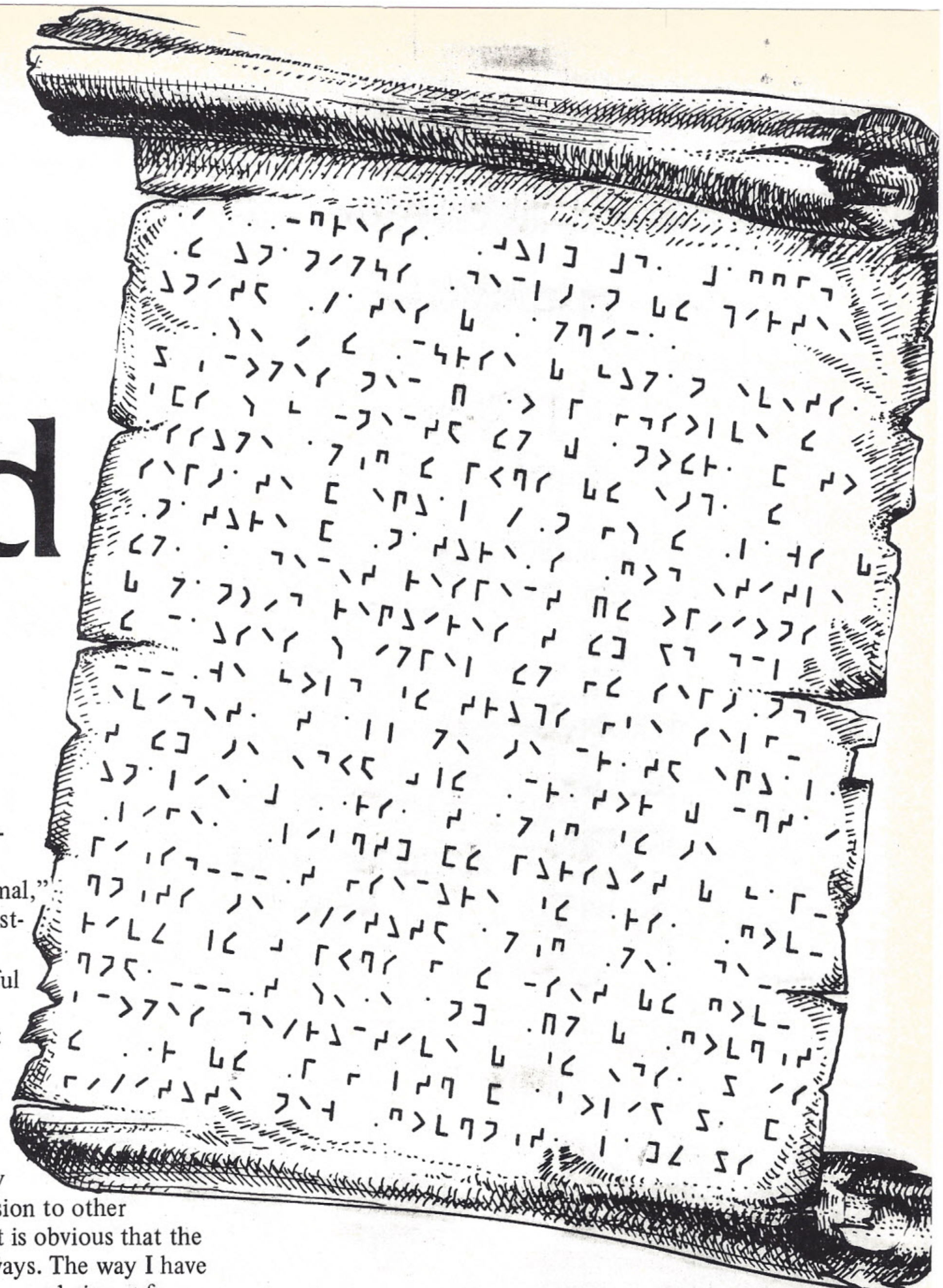
Biorhythm Program

```
0001 REM BIORTM  4-18-77
0020  M$="DAY "
0100 DIM X$(31)
0105 DIM M$(12)
0110  M$(1)="JAN"
0111  M$(2)="FEB"
0112  M$(3)="MAR"
0113  M$(4)="APR"
0114  M$(5)="MAY"
0115  M$(6)="JUN"
0116  M$(7)="JUL"
0117  M$(8)="AUG"
0118  M$(9)="SEP"
0119  M$(10)="OCT"
0120  M$(11)="NOV"
0121  M$(12)="DEC"
0200  P9=6.283185
0300  P1=23
0310  P2=28
0320  P3=33
0400  D1=P9/P1
0410  D2=P9/P2
0420  D3=P9/P3
0430 DATA 31,28,31,30,31,30,31,31,30,31,30,31
0450 INPUT "ENTER NAME",N$
0460 INPUT "M FOR MONTH OR Y FOR YEAR",X$
0500  N1=0
0510 INPUT "BIRTH MO,DA,YR",B1,B2,B3
0520 IF B3<1900 THEN 8000
0530 IF B1>2 THEN 600
0540 IF B1=2 THEN IF B2=29 THEN 600
0550 IF INT((B3-1900)/4)<>(B3-1900)/4 THEN
     600
0560  N1=1
0600 INPUT "ENTER START MONTH, YEAR",C1,C3
0610 IF B3>=C3 THEN 8100
0620 FOR J=1 TO B1
0630 READ X
0640 NEXT J
0650  N1=N1+X-B2
0660 IF B1=12 THEN 702
0670 FOR J=B1+1 TO 12
0680 READ X
0690  N1=N1+X
0700 NEXT J
0702 REM
0705 IF C3-B3<2 THEN 750
0710 FOR J=B3-1899 TO C3-1901
0720 IF INT(J/4)=J/4 THEN N1=N1+1
0730  N1=N1+365
0740 NEXT J
0750 RESTORE
0760 IF C1=1 THEN 810
0770 FOR J=1 TO C1-1
0780 READ X
0790  N1=N1+X
0800 NEXT J
0810 IF INT((C3-1900)/4)<>(C3/4) THEN 900
0820 IF C1>2 THEN N1=N1+1
0900  I1=N1
0910  I2=N1
0920  I3=N1
0930 READ X
0940 PORT= 7
0950 FOR J=1 TO 5
0955 PRINT
0960 NEXT J
0970 PRINT "BIOCHART  --  ";N$
0975 PRINT "BIRTHDATE  --  ";B2;M$(B1);" ";B3
0976 PRINT
0977 PRINT "C=COGNITIVE"
0978 PRINT "P=PHYSICAL"
0979 PRINT "S=SENSITIVITY"
0980 FOR J=1 TO 5
0985 PRINT
0990 NEXT J
0995  L=0
0997 GOSUB 2000
0998  D=0
1000  L=L+1
1100 FOR I=1 TO 31
1110  X$(I)=" "
1120 NEXT I
1130  X$(16)="I"
1200  Y1=INT(15*SIN((L+I1)*D1)+16.5)
1210  Y2=INT(15*SIN((L+I2)*D2)+16.5)
1220  Y3=INT(15*SIN((L+I3)*D3)+16.5)
1250  X$(Y1)="P"
1260  X$(Y2)="S"
```

plots three sine curves with periods of 23, 28 and 33 days and a starting value based on your age (in days). The following two part program for charting biorhythms runs on a SWTPC 6800 system with 8K Basic and a PR-40 printer connected to I/O port 7.

```
1270  X$(Y3)="C"
1280 IF Y1=Y2 THEN X$(Y1)="*"
1290 IF Y1=Y3 THEN X$(Y1)="*"
1300 IF Y2=Y3 THEN X$(Y3)="*"
1350  D=D+1
1360 IF D<X+1 THEN 1400
1365  S1=S1+1
1370 IF S1=12 THEN 9000
1375  C1=C1+1
1377 IF C1>12 THEN 1390
1379 READ X
1380 GOSUB 2000
1385 GOTO 1400
1390 RESTORE
1393  C1=1
1394  C3=C3+1
1395 GOTO 1379
1400 PRINT M$(C1);" ";D;TAB(9);
1450 FOR J=1 TO 31
1460 PRINT X$(J);
1470 NEXT J
1500 PRINT
1600 GOTO 1000
2000 REM PRINT NEW MONTH
2002 IF X9=1 GOTO 9000
2004 IF X$="M" THEN X9=1
2010 FOR J=1 TO 5
2020 PRINT
2030 NEXT J
2040 PRINT "BIOCHART FOR ";M$(C1);" ";C3
2100 PRINT TAB(5);N$
2170 PRINT TAB(10);"(-)";TAB(34);"(+)"
2180 PRINT
2190  D=1
2200 RETURN
8000 PRINT
8010 PRINT "YEAR MUST BE 1900 OR LATER"
8020 GOTO 510
8100 PRINT
8110 PRINT "START YEAR MUST BE GREATER THAN
     BIRTH YEAR"
8120 GOTO 600
9000 PORT= 1
9999 END
```

touch and show



An item in Random Access proposing special notation for hexadecimal arithmetic (See: "Everybody Talks About Hexadecimal," March/April, 1977) provoked some interesting response, mostly negative. One correspondent offered some uncommonly useful information to support the basic notion.

Professor K.O. Beatty, Jr. commented: I would like to propose consideration of the attached set of characters which have the distinct advantage of being easy to learn and remember as well as being computer-compatible. Since they are based on a "logical" system, extension to other numerical bases is possible if desired. It is obvious that the position could be numbered in other ways. The way I have chosen avoids some possible ambiguities, and gives a form

A "LOGICAL" SET OF HEXADECIMAL CHARACTERS

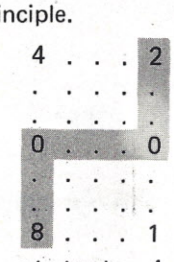
Proposed by K.O. Beatty, Jr., Reynolds Professor of Chemical Engineering, North Carolina State University

Principle: All characters are formed by joining the numbered positions whose total corresponds to the desired character.

Special Considerations: In the arrangement of numbered positions, the 8 and 2 are diagonally opposite and could be joined by a diagonal line. However, some displays have no diagonals, and even in the 5x7 dot matrix now widely used, there is no full diagonal. This problem is avoided by inclusion of the two "dummy" or "zero" positions as indicated. Lines may be drawn thru these without altering the total for the character, a procedure illustrated by the character for ten.

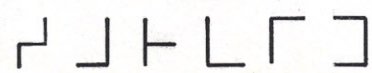
The dummy positions are also used in the character for twelve where they serve to show unambiguously that the vertical line joins the 8 and 4 positions and not the 1 and 2 positions and also to avoid confusion with the character one.

The dummy positions thus serve to make all characters of the same general dimensions unambiguous, and, in the author's opinion, more aesthetically pleasing than some alternative forms based on the same principle.



Locations of numbered positions on a 5 x 7 matrix with character for ten in green.

Hexadecimal Character



Decimal Equivalent 10 11 12 13 14 15

*See line-for-line translation of this Kobigraph on p. 12

and sequence that appeals to me. Perhaps some of your readers might use the same principle to produce forms they prefer.

Professor Beatty added a footnote: "I failed to point out that the ambiguity between my symbol for 13, viz., and the letter ell can be avoided by using the symbol which is also thirteen by my principle, although it uses more than the minimum number of lines."

This is all very interesting if your taste runs to struggles against long established conventions in communication, but Professor Beatty mentioned, almost in passing, an application for this general approach to symbolism that serves a really worthwhile purpose and gives weight to the discussion.

"It might be of interest to you to know that closely related characters have been used by me for a number of years as a set of ink-print, computer-compatible braille analogs for the sighted. I call them Kobigraphs. Braille, as you may know, is based on two columns of three-dot positions each so it is conveniently considered as double octal. The full page enclosure is the preamble to the Declaration of Independence as it appears in kobigraphs."

And another footnote: "You may notice that in the third line I erred and omitted the capital sign before the first word, which is "United." In the fourth line from the bottom, the last word should be "government" and I spelled it "goverment." This is why editing before embossing would be a help. I corrected the imprint version."

The general explanation goes like this:

Braille is a system of sixty-three symbols formed of some combination of dots located in the six positions of a braille cell. These positions form two vertical columns of three with a center-to-center spacing of 0.095 inches between dot locations.

The alphabet takes twenty-six of the symbols. There are 185 short form words. For example each letter of the alphabet stands for a word. The sentence "do you like people" in braille is just the letters "d y 1 p." There are no capital letters in braille. Capitalization is indicated by a single dot in the bottom of the right hand column of the cell preceding the capitalized letter. Two capital signs preceding a word means that all letters in the word are capitalized.

There are no special symbols for numbers. The number sign placed before the letters a through j produces numbers.

I developed Kobigraphs some years ago as a simple way of writing braille in inkprint – much simpler than dots. As the enclosed "Braille and Corresponding Kobigraphic Symbols" sheet shows, the symbols are formed by joining the dots of a braille sign. I use the minimum number of connecting lines to form a continuous character. No line is drawn through an unoccupied position. All symbols except that for k and its complement are made with straight lines.

On the enclosed sheet I have made no effort to make them exactly compatible with the 5x7 display matrix but doing this is a routine matter. Suggested use for these symbols would be for editing (using a CRT display) brailled material produced either by computer or by hand but destined for multiple copy reproduction as by a Triformations high speed brailler.

A raised version of the Declaration was read easily by two blind persons – one actually read several lines before realizing that it was not braille. Sighted persons who know braille quickly learn to read and write Kobigraphs.

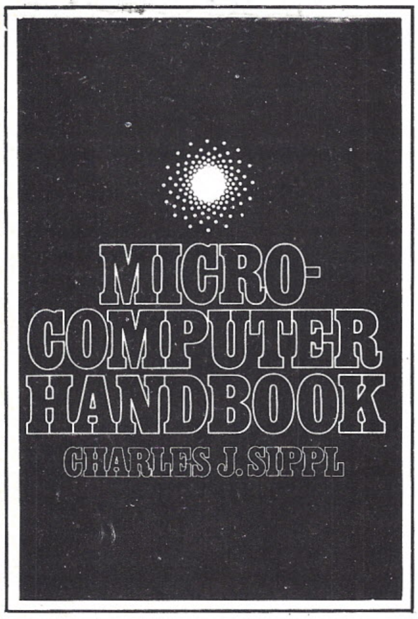
Communication between the sighted and the blind has often been complicated by mutually exclusive writing systems. This work of Professor Beatty's could be of real help.

"This should give you an idea of Braille and its related Kobigraphs. The dots are standard spacing. Not all the dots have meaning by themselves, and a number have more than one meaning. I have indicated just one of the meanings.

It is worth noting that Kobigraphs are easier to read on a CRT than on my sheet, because the smaller character-to-character spacing relative to word-to-word spacing makes the "words" stand out more distinctly. Braille is widely spaced, because of the difficulty of tactile reading."

(Note that this figure is reproduced from the poor coated-paper copy that Professor Beatty was able to provide.)

Stacked Microprocessors: A Better Way To Go?



The following discussion of stacked microprocessors is an excerpt from the Microcomputer Handbook by Charles J. Sippl. Published earlier this year by Petrocelli/Charter, the book covers the basics of microcomputing; it includes hardware fundamentals, programming, development and testing and a variety of applications. You can order the 480 page Microcomputer Handbook for $19.95 direct from Mason Charter Publishers, 641 Lexington Ave., NY 10022.

Exciting, low-cost, and extremely fast throughput advantages have led to coordinated groups of microcomputers that already outperform many of today's standard computers. The difference between a multiprocessing system of, say, 16 microcomputers and 16 standard computers working independently is that the multimicroprocessors share memory; that is, some of the primary memory can be addressed by two or more machines. A more common technique in today's standard computing world is multiprogramming. Multiprogramming means that more than one program can reside in main memory at a time and the central processor can switch among them. This means that the CPU does not have to remain idle while waiting for a job's input/output to be completed. Whenever a job must wait for an I/O operation (it sometimes takes a long time to read some data from a file into main memory), the operating system looks over the set of other jobs in main memory and chooses one whose I/O operation has been completed. If there is more than one CPU, many problems are solved and the user has—multiprocessing. If a job starts running on one processor and is stopped while waiting for I/O, it may be restarted later on another processor. Generally, multiprocessing systems come in two types: master/slave or symmetrical. In a master/slave system, one processor (not necessarily similar to the others) controls the rest. From the user's point of view, the maxicomputer, the Control Data Corp.'s (CDC) 6600 is an example of such a machine.

With LSI, speed limits are imposed only by the speed of light. Electric current moves only one foot per nanosecond.

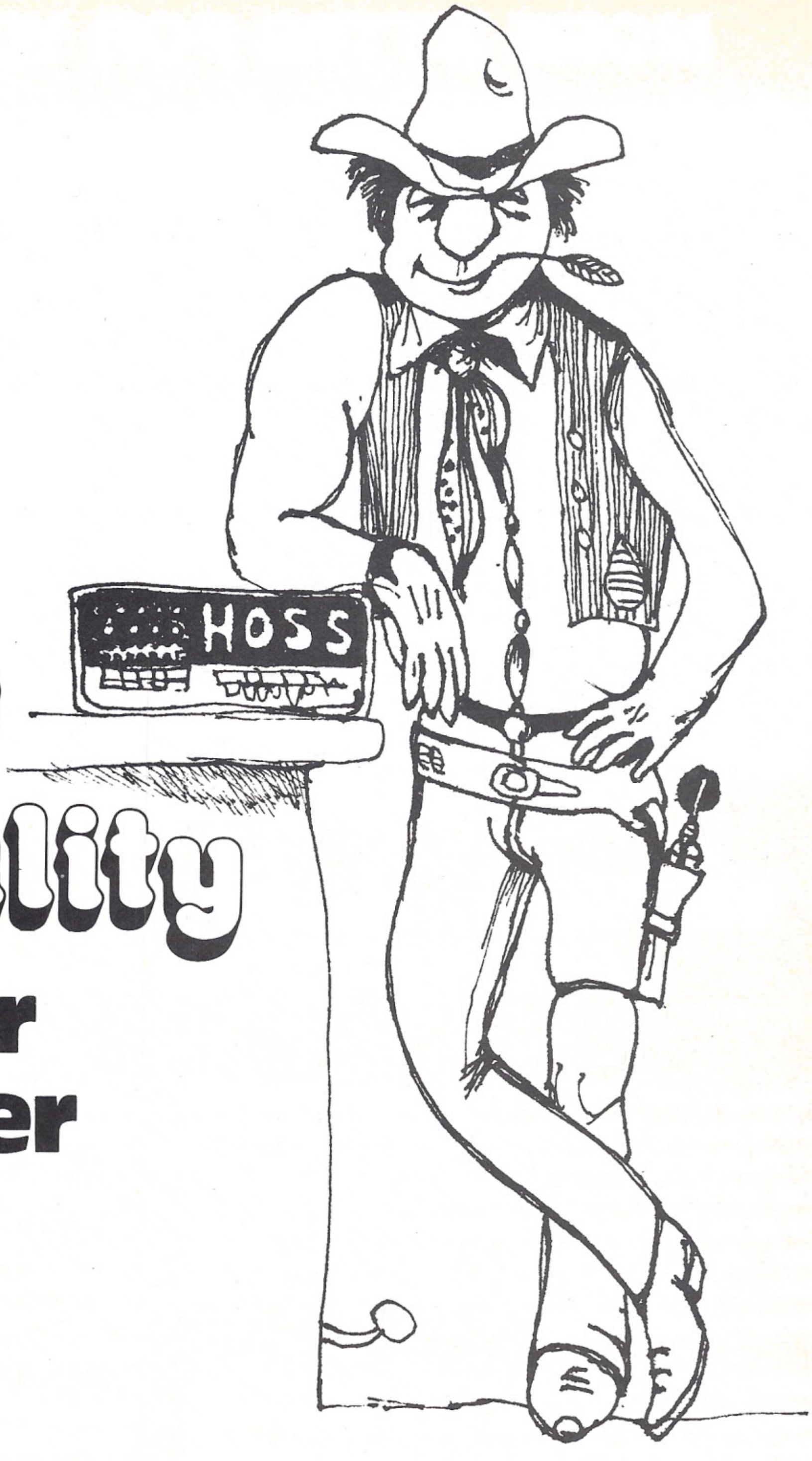
In England, several of the units have been combined to share the work load. In addition to the truly modular systems in which processing capability is added in units rather than by system replacement, the use of multiple processors of the same design has added greatly to system reliability. Low-cost processors easily operate in tandem and choose jobs in priorities. Several "spares" are added, and, in the event of one unit's failure, to ensure system integrity, the next "spare" takes over. This is not the case for many large computers that use multiprocessor designs. Several units in the micro systems are always identical. They might as well be built of many of the same units because they are so cheap. Systems may use one microprocessor for a storage manager; another, for communications; and still others, for compilation, execution, and job scheduling. They provide performance equivalent to current million-dollar systems for only a few thousand dollars. Although the speed of individual microprocessors may be limited, several units now easily run out of phase with each other to provide smooth, fast, and powerful processing. Races between memory speeds and processor speeds are forcing new architectures to evolve utilization of the latest technological states of the art, as they have in the past.

Economies of scale have been obliterated. Function alone no longer defines the types of computers that are purchased. Ranges of systems from pocket-calculator types through centralized giants do share technology but not design. Micros have new functions, new power, new component speeds, and great new system capabilities. Wide ranges of user firms have been seeking new ways to use new microcomputers—to control very fast processes like graphic displays, plotters, radar, and so on.

Reprinted courtesy of Digital Design.

More Personality for your computer

by Alfred Liquors



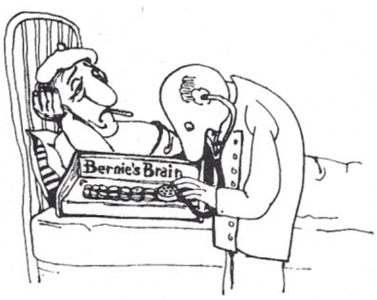
The personal computing revolution involves not only dramatic changes in computer systems, but changes in Society's attitudes toward computers as well. Even now, it is startling to recall some of the attitudes that were firmly entrenched just a decade ago, but are now weakening appreciably.

For example, people in the professional computer trade used to fret a great deal about the personification of computers; they squirmed uneasily when speakers or writers spoke of computers as "he" or "she." They objected strongly when descriptions of computer operations included phrases like "the computer thinks that the data. . . " All such personification of hardware systems was sternly eliminated from literature over which the worriers had control. In all good faith, the professional people tried to avoid creating confusion about the capabilities of computers,

tried to do a good, straight job of representing computers as the limited, not-really-mysterious machines they are.

Unluckily for them, they were working against human nature. Their battle against personification was lost perhaps twenty-thousand years ago, when the first master of a reed barge referred to the vessel as "she." Certainly the handwriting on the wall was crystal clear by the time people were calling their Model T's "Tin Lizzie."

As soon as computers began to escape the control of a small, ingrown band of specialists, the jig was up for the anti-personification people. Pockets of resistance are still around, but the war is over. In retrospect, the caution of the worriers seems sensible. The Frankenstein syndrome was very powerful all during the early years of computing, when the general public had no way to deal with computers directly, and considered them eerie and mysterious. If jolly, irreverent people in the business had been turned completely loose, their excesses might well have hindered the development of systems now so welcome. So, a tip of the



hat to the pioneers, and on we go.

Personal computers are developing real personality, making smart-aleck comments in their responses to users, showing odd little behavioral traits that are products of their not-quite-perfect design and construction. Owners are growing attached to their computers (or growing to hate them, take your pick). . . and they are moving on from the plain "he" and "she" stage to more elaborate nomenclature.

In fact, they are aided in this effort by the likes of Computer Mart of New Jersey (501 Route 27, Iselin, New Jersey 08830), which is offering custom-made front-panels for the IMSAI and SOL computers that dot the landscape. Some thoughtful observer at Computer Mart noticed that front panels on these machine are clear plastic, under which printed material is placed to identify the machines and controls. It is the work of just a few minutes to replace one sheet of graphic material with another. Aha! Computer Mart of New Jersey now offers a handy service to computer-personifiers who want to personalize their personal SOL's and IMSAI's.

It is only necessary to send the company a camera-ready drawing with lettering, or an idea that the firm's advertising department can render professionally. Oh, yes, it is also necessary to send fifteen dollars to get the earnest attention of the company.

Shortly after receipt of your cash and material, Computer Mart will send you a nice, clean photonegative version of your chosen image, a sheet of plastic that can be sandwiched into your computer to give it the name and charac-

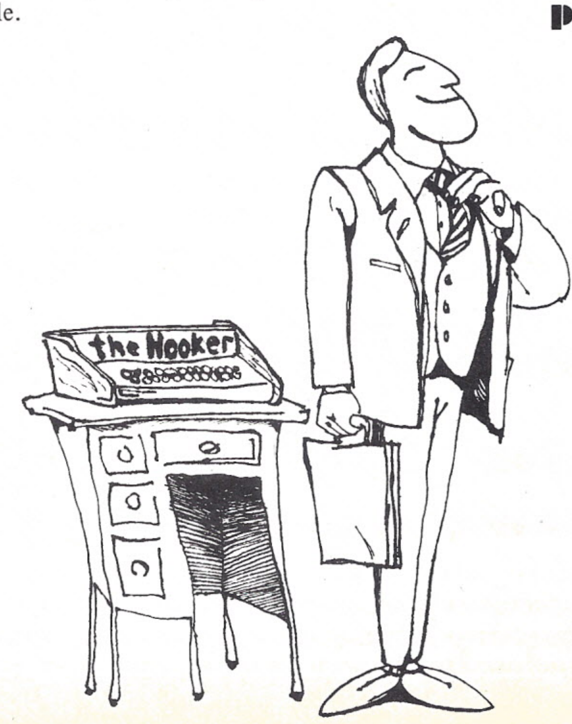
ter you have wished for.

The possibilities are endless. Many chosen are not fit to print, many are dull, some wildly imaginative. Many slogans appear – Don't Tread on Me – Peace – Remember the Eniac – Up Algol – Touch Me and I'll Scream. Kilroy gets a lot of work. So does Hal. Artoo-Detoo's Cousin is busy, as is Mama's Microwave Oven.

Ever since people began to hang around taverns instead of going home from work, cover names for saloons have flourished. "Hello, my dear. I'm still at The Office." "I'm sitting up with A Sick Friend." Some of the worn old names apply well to the computers. Von Neumann's Revenge is newer. π-slicer. Number Cruncher. Word Mangler . . . Cuddles, Sylvester, Spock, Motie, Susan Calvin. . . and the beat goes on.

Times have surely changed. With or without genuine understanding of computer technology and its implications, people have grown accustomed to personified computers – not just movie machines, but working computers.

Come on, Alfalfa, let's figure out the feed mix for the cattle.



Parks looks upon the development of ideas in computing and articles resulting therefrom as a sort of peaceful husbandry in which good items are encouraged to grow and produce something of value.

what do you do when you find a cow?

(answer: you milk it)

by Don Parks

Here is a scenario describing someone's cow —

WHAT IF Someone developed a low cost computer output device (like maybe a device controlled by their computer to produce tones in a loud speaker) that would make an interesting addition to computer games . . . and they wrote an article describing the device and how to attach it to the computer and included a short program to test it . . . and sent the article to Personal Computing.

AND Personal Computing published the article and sent them a check for $40

THEN They wrote a program to produce some neat game sounds — like groans for wrong answers and whoee's for right answers . . . and they sent the program to Personal Computing.

AND Personal Computing published the program and sent them a check for $70

THEN They get the editor of Personal Computing hooked on a sound of the month column.

AND Each issue of Personal Computing gives its readers a new game sound and the author gets a check for $30

THEN The author modifies the device for a different make of microcomputer chip, rewrites the software, writes another article and sends it to Personal Computing.

AND Personal Computing publishes the article and sends a check for $50

THEN The sounds of the month column grows to cover two computer types.

AND Personal Computing sends more checks for $40

THEN **Conclusion:** There are a lot of cows in computerland. In general, every program written for one make of microcomputer must be rewritten for every other make (and a new magazine article each time). Now is the time to stake out your cow and start milking.

EDITOR'S NOTE: Beware of that cow. She may kick you into the next county, hook you with a horn, or shatter your dignity by swishing your face with a scraggly tail. It's important to remember at all times who's supposed to be in charge of the situation.

The Editor of PERSONAL COMPUTING, color blind and with tin ear, is not hooked on sound of the month, and does not aspire to become hooked. That steady flow of checks from the magazine envisioned by the author is not automatic.

But Parks is right. Very little in this world is really new, and a small body of technical information can be molded into a thousand forms, placed in interesting new context, decorated in facinating ways. Each new presentation of the same material can give the observer a useful new insight. PERSONAL COMPUTING wants to buy and publish articles that provide useful insights, information and entertainment to readers.

If you survive the struggle to stake out the cow, we'd like to see what you get from her — just samples of the milk, actually. Keep the rest.

PC

CIRCLE 32

CIRCLE 33

CIRCLE 34

CIRCLE 35

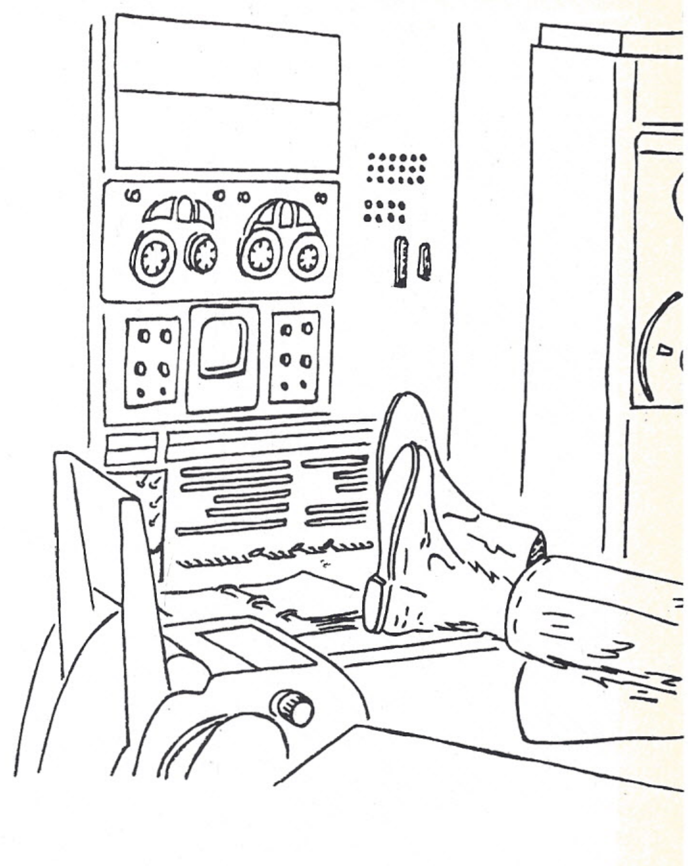
THE PROGRAMMABLE POCKET CALCULATOR:

by James C. Pittman, Jr.

In several ways the pocket calculator is a forecast of things to come in the world of personal computing. It is portable, it doesn't cost much and it is easy to use, performing calculations of surprising complexity. It can help change attitudes toward mathematics and toward methods of getting answers to questions. It introduces people to computers more surely and more pleasantly than computerized bank accounts or computerized grocery checkouts, because the calculator is a personal computing device which owners can control and use whenever or wherever they wish.

As better computers and calculators become available, the dividing line between them becomes more and more blurred. Old definitions of "computer" will have to be modified as calculators become more versatile. John von Neumann in 1944 specified five parts of a computer: Central Arithmetic, Central Control, Memory, Input and Output. Further, he specified that a computer would do no parallel processing (as early calculators did) but would have a string of instructions which would be executed automatically, one at a time, in order. Programming such a sequence of instructions was entirely logical and relatively easy. By using electronic devices for the first three parts, the computer could operate fast enough to be useful . . . after all, the only advantage of a computer over a person with a pencil and paper is its ability to do a great many rather simple operations very fast. If we use the von Neumann specifications, we must classify the HP-65 as a computer, since it has all five parts and can be programmed to carry out instructions automatically in serial order.

Another popular definition of a computer is its ability to manipulate alphanumeric data, not just numbers. This definition only weakly excludes present calculators and probably won't exclude the next generation. Any computer turns alphabetic characters into binary numbers to operate and then binary codes are turned back into characters for display. The popular "Star Trek" game has been programmed for a pocket calculator and such commands as "Fire forward phasers" and "Maneuver to engage" are entered as code numbers. Granted, the operator has to translate the code, but this doesn't prevent your playing a pretty complicated and challenging game. Many calculators now use word displays such as "Error" to indicate an improper operation, "Crd" to show that a card is to be read in, and "OF" to indicate register overflow. Users have learned how to generate other such words and phrases in their calculator's display windows, and use them as program cues or as output information.



AN INTRODUCTION TO PERSONAL COMPUTING

Still another claim to computer exclusivity is the claim that only a computer can treat its instruction codes the same way as it treats its data codes; that is, it can modify its own instructions. This is not a very satisfactory criterion in some ways. For one thing, being able to self-modify a running program is not necessarily something to be desired. With modern, powerful computers it is usually better to avoid the debugging and code storage problems associated with self-modifying programming. For another thing, some calculators are capable of a limited amount of self-modifying programming, the SR-52 directly and the HP-67 indirectly, and users are now learning how to get into the HP-67's program memory so that programs can be written in which program and data codes can be exchanged. This opens up interesting and useful possibilities.

Illustration by James C. Pittman, Jr.

The most reasonable dividing line between computers and calculators seems to be the degree of generality for which the machine is designed. This definition can be revised as computers become smaller and as calculators become more flexible. Calculators tend to be very input-output limited: input is only as fast as you can press the keys, and output is only as fast as you can read and copy down the displayed numbers. But again there are exceptions. The HP-65 and later machines allow you to read in programs very rapidly with a small magnetic card; some machines can read in or write out data on these cards. The SR-52 and SR-56, both pocket-sized, can print out data or program steps on a detachable printer unit. One student built an inexpensive cardreader to interface with his HP-25 so that he could read in data or program code rapidly from punched cards. Another built an interface to allow his programmable calculator to be controlled by a quartz-crystal timer. Users have learned how to write special programs for the HP-97 so that it can print alphanumeric characters or graphic displays. And finally, several programs have been written in which the RF-interference noise from the calculator display is used to modulate the tone from a portable AM radio to act as an audio output signal.

Many of the functions that earlier seemed clearly to be in the domain of computers have been assumed by the newer pocket calculators. The dividing line between calculators and computers will probably remain hazy, but is probably best thought of in terms of the generality and flexibility of the computing system.

Programmable calculators may be divided into three classes: key programmable, card programmable and cartridge programmable. Key programmable machines

S.D. SALES COMPANY

NOW-THE ULTIMATE RAM BOARD

MEMORY CAPACITY
MEMORY ADDRESSING
MEMORY WRITE PROTECTION
8K, 16K, 24K, 32K using Mostek MK4115 with 8K boundaries and protection. Utilizes DIP switches. PC board comes with sockets for 32K operation. Orders now being accepted allow 6 to 8 weeks for delivery.

Available the 1st quarter of 1978: 16K, 32K, 48K, 64K using Mostek 4116 with 16K boundaries and protection.

32K FOR $475.00

Buy an S100 compatible 8K Ram Board and upgrade the same board to a maximum of 32K in steps of 8K at your option by merely purchasing more ram chips from S.D. Sales! At a guaranteed price — Look at the features we have built into the board.

PRICES START AT $151. FOR 8K RAM KIT
Add $108.00 for each additional 8K Ram

Board fully assembed and tested for $50. extra.

8K FOR $151.00

INTERFACE CAPABILITY
Control, data and address inputs utilizes low power Schottky devices.

POWER REQUIREMENTS
+8VDC 400MA DC
+18VDC 400MA DC
−18VDC 30MA DC
on board regulation is provided. On board (invisible)refresh is provided with no wait states or cycle stealing required.
MEMORY ACCESS TIME IS 375ns.
Memory Cycle Time is 500ns.

8K LOW POWER RAM - $159.95

Fully assembled and tested. Not a kit.

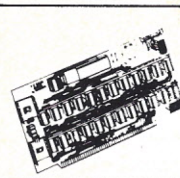
Imsai —Altair — S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.

4K LOW POWER RAM KIT

Fully Buffered — on board regulated — reduced power consumtpion utilizing low power 21L02 — 1 500ns RAMS — Sockets provided for all IC's. Quality plated through PC board. *Add $10. for 250ns RAM operation

The Whole Works-$79.95

Z-80 CPU BOARD KIT - Complete Kit $139.



CHECK THE ADVANCED FEATURES OF OUR Z—80 CPU BOARD: Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply; always stops on an M1 state, true sync generated on card (a real plus feature!), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board; parts plus sockets priced for all IC's. *Add $10. extra for Z—80A chip which allows 4MHZ operation. Z—80 chip with Manual — $39.95

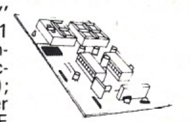
MUSICAL HORN

One tune supplied with each kit. Additional tunes — $6.95 each. Special tunes available. Standard tunes now available: —Dixie — Eyes of Texas — On Wisconsin — Yankee Doodle Dandy — Notre Dame — Pink Panther — Aggie War Song — Anchors Away — Never on Sunday — Yellow Rose of Texas — Deep in the Heart of Texas — Boomer Sooner — Bridge over River Kwai

Special Design Case $3.50

CAR & BOAT KIT **$34.95** HOME KIT **$26.90**

DIGITAL LED READOUT THERMOMETER - $29.95



Features: Litronix dual 1/2" displays. Uses Silicoaix LD131 single chip CMOS A/D converter. Kit includes all necessary parts (except case); AC line cord and power supply included. O-149° F

6 DIGIT ALARM CLOCK KIT

Features: Litronix dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). Xfmr optional. Eliminate the hassle — avoid the 5314! Do not confuse the Non — Alarm kits sold by our competition!
AC XFMR — $1.50 Case $3.50 **$12.95/kit**

Jumbo LED Car Clock Kit

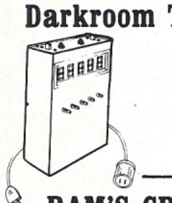
$16.95

FEATURES:
A. Bowmar Jumbo .5 inch LED array.
B. MOSTEK — 50250 — Super clock chip.
C. On board precision crystal time base.
D. 12 or 24 hour Real Time format.
E. Perfect for cars, boats, vans, etc.
F. PC board and all parts (less case) inc.
Alarm option — $1.50
AC XFMR — $1.50

Bowmar 4 Digit LED Readout Array

4 JUMBO .50" DIGITS ON ONE STICK!
WITH COLONS & AM/PM INDICATOR
$3.95

5 Digit Countdown Utility— Darkroom Timer Kit - $44.95



Features: Large LED ½" displays, crystal controlled Mostek 50397 counter display driver, set timer at 0.1 second precision from 0.1 second to 59 minute 59.9 second, 5A-115V relay included to control photographic enlarger, sun lamp, appliances, TV, or other equipment, operates on 115V AC, displays can be turned off for total darkness applications, simple push button operation, use in kitchen, school, office or laboratory. All necessary parts included. Special design case $3.75

6 Digit General Purpose or Computer Timer Kit - $29.95

Features: Large LED ½" displays, Mostek 50397 counter display/driver, counts up to 59 minutes, 59.99 seconds with crystal controlled 1/100 second accuracy, operates on 115V AC or 12V DC supply. Use it to time telephone calls, athletic events, practice time, school and laboratory demonstrations, experiments, chess games, etc. Time computer functions in real time such as run times on programs, sub routines and other computer controlled events. Requires two output channels for start/stop and clear controls. All necessary parts included. Special design case $3.75

Full ½" Litronix Jumbo Dual Digit LED Displays

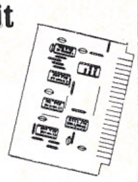
DL 722 - C.C.	DL 728 - C.C.
DL 721 - C.A.	DL 727 - C.A.
99c	$1.29

RAM'S•CPU'S•PROM'S

21L02 - 500NS	8/11.50
21L02 - 250NS	8/15.95
2114 — 4K	14.95
1101A — 256	8/$4.00
1103 — 1K	.99
MK 4115 - 8K	19.45
74S 200 - 256	3.95
Z—80 includes manual	29.95
Z—80A includes manual	34.95
8080A CPU 8 BIT	11.95
8008 CPU 8 BIT	6.95
1702A - 1K - 1.5us	3.95 or 10/35.
2708 - 8K Intel - 450ns	14.95
5204 - 4K	7.95
82S129 — 1K	2.50
2708S - 8K signetics 650ns	9.95

Low Cost Cassette Interface Kit

$14.95



Features: K.C. standrad 2400/1200 Hz, 300 Baud, TTL, I/O compatible, phase lock loop, 22 pin connector. Feeds serial data via microprocessors I/O ports and from cassette tape recorder. $14.95

DISC CAP ASSORTMENT * PC leads. At least 10 different values. Includes .001., .01, .05 + other standard values 60/$1.00

39 MFD 16V Mallory Electrolytic 15/$1.00 *

* 1000 MFD FILTER CAPS Rated 35 WVDC. Upright style with PC leads. Many popular values. 4/$1.

JOY STICKS! 4—100K POTS $3.95 each

RESISTOR ASSORTMENT * PC leads A good mix of values. SPECIAL! 200/$2.00

FLAT PACK 5400 SERIES * 20 asst. devices for $1.00

Microprocessor Chips

8212 - I/O port	3.50
8214 — P.I.C	12.95
8216 — Non Invert Bus	4.95
8224 — Clock Gen.	4.95
8226 — Invert Bus	3.95
PIO for Z—80	14.95
CTC for Z—80	14.95
8228 Sys. Controller	8.20
8251 Prog. comm. interface	10.95
8255 Prog. perp. interface	13.50
8820 Dual Line Recr.	1.75
8830 Dual Line Dr	1.75
2513 Char. Gên	7.50
8838 Quad Bus. Recvr.	2.00
74LS138N — 1/8 decoder	.99
8T97-Hex Tri-State Buffer	1.25
1488/1489 RS232	1.50
TR1602B Uart	3.95

Counter Chips

MK50397 6 Digit elapsed timer	8.95
MK50250 Alarm clock	4.99
MK50380 Alarm chip	2.95
MK50396 6 digit up/down counter	12.95
MK5002 4 digit counter	8.95
MK5021 - Cal. chip sq. root	2.50

ITT DUAL SENSE AMPLIFIER 75234 and 75235 49c each *

SPRAGUE DUAL DIFFERENTIAL AMP. TD101 49c each

P.C. LEAD DIODES * 1N4148/1N914 100/$2.00

POWER RESISTOR 15 OHM 25W by CLAROSTAT 75c Each

ITT PART NO. SAJ 110 Ideal for electronic music circuits 7 stage freq.dividers. 49c each

S. D. SALES CO. An Empire Ind. Co.

P. O. BOX 28810 — P
DALLAS, TEXAS 75228

Call in your Visa or Mastercharge in on our Toll Free Watts Line:
1—800—527-3460

Texas Residents call Collect:
214/271—0022
Dealer Inquiries Invited!

60 DAY MONEY BACK GUARANTEE!

NO COD's. TEXAS RESIDENTS ADD 5% SALES TAX. ADD 5% OF ORDER FOR POSTAGE & HANDLING. ORDERS UNDER $10. ADD 75c HANDLING. FOREIGN ORDERS — US FUNDS ONLY!

Choose $1. Free Merchandise From *Asterisk Items on each $15. Order!

CIRCLE 36

include the popular and inexpensive SR-56 and HP-25 whose programs must be keyed in each time the calculator is used. Card programmable calculators include the HP-65, the SR-52 and the HP-67 and are programmed by reading in a small pre-recorded magnetic card. Program packs can be bought from the manufacturer or you can record your own programs on blank cards. Newer calculators such as the NS-7100 and the SR-58 replace the mechanical card reader with small, solid-state plug-in memory units which contain pre-recorded program steps and constants. It may be expected that future calculators will incorporate more program memory, either as solid-state devices or in the form of cassette tape recorders.

An informative article on the basics of programmable calculators may be found in the May 1976 issue of *Popular Electronics*: "Here are the New Programmable Calculators" by Forrest Mims; it discusses a

a little history

In the sixties computers were beginning to come into the awareness of the general public. They were incomprehensible products of technology, used for obscure and not quite trustworthy purposes. Eventually we were more directly confronted by computers in such forms as computer-printed bills and checks, and the phrase "computer error" became a common substitute for "somebody made a mistake." In the movies it was a cliche to show scientists in a large room filled with blinking lights and reeling tapes. Captain Kirk was always getting Spock to analyze sensor data on the ship's computer (but you will recall that he never really trusted the results enough to let the computer make his decisions). The networks predicted election returns by computer, and when space vehicles were out of radio contact behind the moon, computer simulations were used on television to show us what they were doing. Of course we knew that everything at NASA was computer controlled. Thanks to such developments, computers were becoming part of everyday life even if they were not understood.

In 1970 the first pocket-sized electronic calculator became available. To be sure, there had been many personal calculating devices available before: slide rules, mechanical hand-cranked calculators, logarithm tables, the abacus. The new electronic machine didn't do much beyond the four arithmetic functions and it cost a lot. But it was a magic thing, calculating numbers to eight-digit accuracy and displaying them instantly with glowing segmented numbers.

Within two years the calculator revolution was well underway and two trends were becoming clear. First, prices were dropping rapidly, so more people were buying the machines. Second, calculators were appearing with several higher mathematical and scientific functions, and these machines could handle ever more complex problems with relative ease. In August of 1972 the first scientific "slide rule" calculator was advertised in *Science* magazine, in all seriousness, as a "pocket computer."

This was not by any modern definition a "computer," and by 1977 standards it is quite obsolete. But it contained more calculating power in its pocket-sized package than had ever been available before the computer. It met with instant success among scientists and engineers. A new market had been created, and it did not take long for improved models to appear. In early 1974 the first programmable pocket calculator appeared, with capabilities so far beyond the first calculators that there is hardly any comparison.

Today many high-quality programmable models are available, with more power, flexibility and convenience, and prices are still going down. For under ten dollars you can get virtually error-free arithmetic on a four-function machine. For less than $30 a scientific model provides more computing power than any slide rule. (The original HP-35 cost $395 in 1972.) Programmable models are available for under $100. Nobody buys slide rules anymore, and the question you ask a student in science or engineering these days is not "Do you have a calculator?" but "What kind?"

A recent museum exhibit on energy research and technology included a display that vividly depicted the changes in possibilities for personal computing. An old computer sat next to a wall full of aerial photographs showing scenes along an interstate highway: cloverleafs, bridges, exit ramps with banked turns, merging entry ramps. Signs explained that the computer was a Bendix G-15 that cost some $50,000 in 1959, and that it had seen extensive use in the design and planning of the state's interstate highway system. The computer, about the size of a large upright freezer, looked businesslike but unfamiliar. It wasn't very pretty and looked more like an oversized antique radio set than a computer.

Below the wall of photos was a small display case containing a pocket calculator and six program cards. A sign explained that the calculator was a programmable model, was about as fast as the computer, was easier to program, was capable of equivalent computing performance, and cost less than a thousand dollars. (If the display were being planned today it would be possible to show a pocket calculator some ten times as powerful costing four hundred dollars.)

Scientific and financial calculators are impressive enough, but programmability opens up a whole new dimension in calculating, getting right into the realm of personal computing. The language is different, but as in a computer, the program steps must be logical and correct to get the right answer. Programming requires patience and discipline, and debugging is usually a big part of your programming time. You get the satisfaction of understanding exactly what that program does, or of finding a pleasingly elegant way to save a lot of program steps, or of making the program run faster, or of having the program accept data the way *you* want it to rather than the way some factory programmer thought it should be. Most important, you can write, modify, or run your programs whenever and just about wherever you want.

wide range of calculators with sample programs.

Counterpoint

Another picture of the role of calculators in personal computing should be considered: working scientists and engineers often do not find the utility of calculators as great as they expected. There are several reasons for this opinion.

First, while the typical pocket programmable is capable of very powerful computations, it is a time-consuming task to write programs for such applications. For the hobbyist this is part of the fun, but for a person whose main interest is solving a particular problem, it may be more efficient to wait until a computer is available, or solve the problem "by hand," or look for some other method. This is particularly true of one-of-a-kind problems; it makes little sense to invest a lot of time in writing a program if the program will be used only once.

Another facet of the routine use of calculators is a lack of communication about the capabilities of programmable calculators. The HP-65, for example, was supported by the manufacturer with a user library, but no such library was maintained for the HP-55 or the much more popular and quite powerful HP-25. It has fallen to users' clubs and a few magazines to publish a variety of programs in many disciplines. If an individual is not a member of such a club, or happens not to read such magazines, he may not find out about programming tips or even complete programs that he might find useful. Users' clubs typically exchange a wealth of programming information that far outdistances the material presented in owner's manuals or program packages.

During the last couple of years new machines have been introduced at a rate much greater than that of software the machines can use. Even if a manufacturer tries to maintain a users' library, it is impossible to keep up to date.

No one wants to go back to the days of using slide rules for quick approximations and log tables whenever more than four digit accuracy is needed. One of the values of a programmable calculator is its ability to save time with relatively simple calculations. These "minor" time-saver uses amount to a tremendous saving in time that can be used to do other things beside calculations.

A Real Place

Calculators today are providing many of the capabilities of computers at times and places where computers are not available. But perhaps most important to readers of this magazine who are interested in the computer hobby, the programmable calculator has for thousands of people been the first step in developing an interest in home computers. This has contributed to the marketing of better and cheaper computers, as well as turning many more inventive minds to the problems of computer hardware and software development. Not only is the end not in sight; it is obvious that we have barely begun.

So the next time the kid down the block tells you his SR-56 is a computer, smile tolerantly, point out his error in terminology if you wish, and ask him to show you what his machine will do. You may be surprised!

selecting personal

For routine lab or field use the calculator with the most built-in functions or the easiest or simplest programmability is likely to be more useful than powerful but less convenient machines. For example, the HP-55 has such built-in functions as linear regression, factorial, 20 addressable data registers, several English-Metric conversions and even a 100-hour timer. For some users these features may be more useful than the superior programmability of the HP-25. On the other hand, the HP-25 is much lighter and compact for actual "shirt pocket" portability. If the manufacturer's programs will be used, calculators with card readers or provision for plug-in memory cartridges are very convenient. If you expect to write your own programs, the calculator's programming, editing and debugging features become more important.

The controversy about the superiority of Reverse Polish Notation over Algebraic logic is partly real and partly a matter of personal preference. The Algebraic Operating System with parenthesis is certainly easier for the beginner to use, but RPN enthusiasts insist that Reverse Polish offers greater flexibility in complex problems and in program editing.

The "best" calculator is not necessarily the most powerful, but rather the one that best suits the user's needs. Many factors are important: cost, size, "feel" of the keyboard, even appearance of the display. The manufacturer's reputation for service is an important point. Ease of programming and ease of non-program use may be a large part of daily use of a calculator. Finally, a vital question is the availability of software. The oldest programmable pocket calculator can boast of over 5000 programs in the manufacturer's library, with many more available from clubs, magazines and other sources. It is possible but not always easy to rewrite programs to run on newer machines. As ever more powerful calculators become available, software is more and more a limiting factor in their full utilization.

HP-65 (January 1974) This Hewlett-Packard machine was the first programmable pocket calculator. It is "fully programmable" because pre-recorded magnetic cards are used to read 100-step programs into the machine, or the user can write programs and record them on cards for later use. Used HP-65s may be available at prices up to $300.

HP-55 (December 1974) This was the first key-programmable pocket calculator. It has no card reader so a program in the machine is lost when it is turned off. Prices for a used HP-55 may range as high as $150.

HP-25 (July 1975) A less expensive, smaller and quite popular key-programmable machine, this calculator has 49 fully-merged program steps. Price is $125.

SR-52 (September 1975) Texas Instruments' first pocket-sized programmable calculator at first glance seems to be a copy of the HP-65, but its 224 program steps, 20 addressable data registers,

two levels of subroutines and other features give it considerably greater computing power. It can be used with a $200 desktop printer unit. Current price is about $300.

SR-56 (January 1976) For some time this has been the low-cost leader in quality key-programmable calculators. It has 100 steps of non-merged program memory and has subroutine capability. It can use the same printer as the SR-52. Price is $100.

HP-25C (July 1976) This is the first pocket calculator to feature non-volatile memory; neither program steps nor data are lost when the machine is turned off. All other features are the same as the HP-25. Current price is about $160.

HP-67 (July 1976) This machine may be regarded as a perfected and greatly expanded version of the HP-65. Its magnetic cards contain up to 224 steps of fully-merged program code and may record data from 26 addressable registers. ("Fully-merged" means that each step contains a complete instruction. For example, on the HP-65 or -55 the instruction "STORE, +, 9" *would* require three steps, but on a fully-merged machine it requires one step.) The HP-67 is rated by users with experience with both machines as being five to ten times as powerful as the HP-65. Price: $450.

HP-97 (July 1976) This portable calculator is small enough to fit into a briefcase and has a thermal printer. All functions, programs and magnetic cards are identical to those of the HP-67. Current price is $750.

TI-59 (July 1977) This machine combines the features of the SR-52, including card reader and printer compatability with a powerful addition: plug-in ROMs which have 40,000 bits of storage in the form of programs and subroutines to be added to the machine's built-in functions. Also, the TI-59's memory can be partitioned between program steps and data registers, giving up to 960 program steps. Data registers can be specified by the user at the exchange rate of eight program steps per one added register. The ROM provides up to 5000 program steps. The calculator has over 175 functions and operations. A new thermal printer unit provides program-controlled alphanumeric printing capability. Price for the TI-59 is about $250.

TI-58 (July 1977) This key-programmable machine is very similar to the TI-59 but lacks a card reader. It accepts the ROMs and the thermal printer. Price $125.

TI-57 (July 1977) This key-programmable calculator replaces the SR-56 as the low-price leader. It features 50 fully-merged program steps. Price is about $75.

HP-29C (mid-1977) This key-programmable calculator is the same size as the HP-25 but has continuous memory and programming power much like that of the HP-67. It does not have a card reader. Price is about $200.

NS-7100 (mid-1977) National Semiconductor's entry into the top-level programmable pocket calculator field features all-solid state memory, with plug-in cartridges to provide 4000 program steps in addition to the 240 built into the machine. Price $400.

PROGRAMMABLE CALCULATOR USERS' CLUBS

Users' clubs can be valuable sources of information on calculator hardware, programs, programming tips and future developments. Here are two.

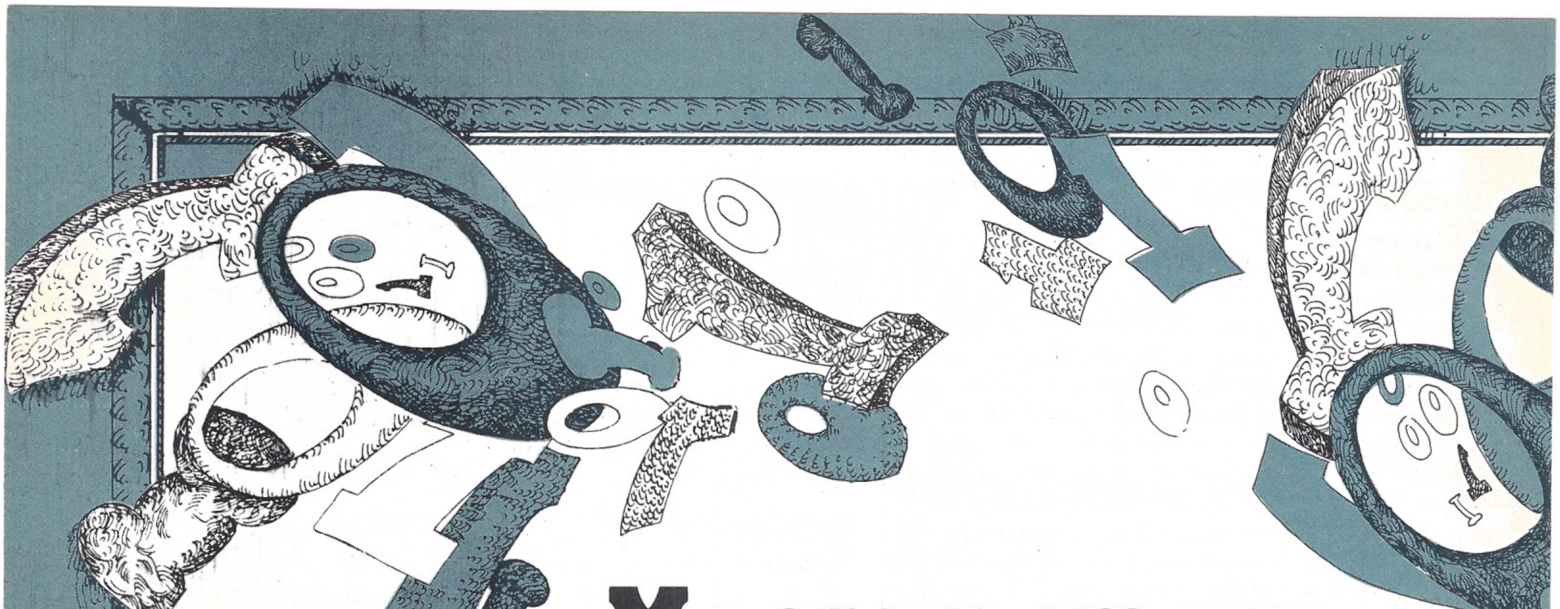
HP-65 Users' Club
65 NOTES, Editor Richard J. Nelson
2541 W. Camden Place, Santa Ana, CA 92704
Supports all Hewlett-Packard programmable calculators.

SR-52 Users' Club
52 NOTES, Editor Richard C. Vanderburgh
9459 Taylorsville Road, Dayton, Ohio 45423
Supports all Texas Instruments programmable calculators.

The concept of personal computing, so recently started, is in a transition period, with changes coming faster than they can be accounted for. Someday perhaps all schools will provide specialized calculators or sophisticated computer programs as aids in teaching mathematics, but today many students have access to calculators, which, by eliminating the drudgery of mathematics, help to clarify its theoretical concepts. Those of us who struggled through calculus or trigonometry "the old-fashioned way" can use our calculators to review pleasantly the math we painfully half-learned long ago.

Someday, perhaps, scientists and engineers will have portable true computers or radio-linked terminals to take with them into the field or on trips. Today many are already using calculators to help in data collection, data analysis, and decision-making. Some engineers use programmable calculators to try out various approaches to a problem that will later be incorporated into a computer program; others run a computer compiler program to write a program for a calculator quickly so that the calculator can later be used in the field for complex calculations that would be time-consuming and tedious to program "by hand."

Someday, perhaps, no one except a few specialists or hobbyists will learn programming, because computers will be fast and powerful enough, and memory will be cheap enough, to allow the computer to be equipped with a program that will accept ordinary English sentences typed on a keyboard or maybe even spoken into a microphone. Today people who don't yet have free access to a terminal or don't yet have their own computer can learn the general logic, discipline, and the philosophy of programming with an inexpensive calculator. They can write programs to carry out useful calculations, to impress their friends, or just for fun.



Macromemory For Microcomputers

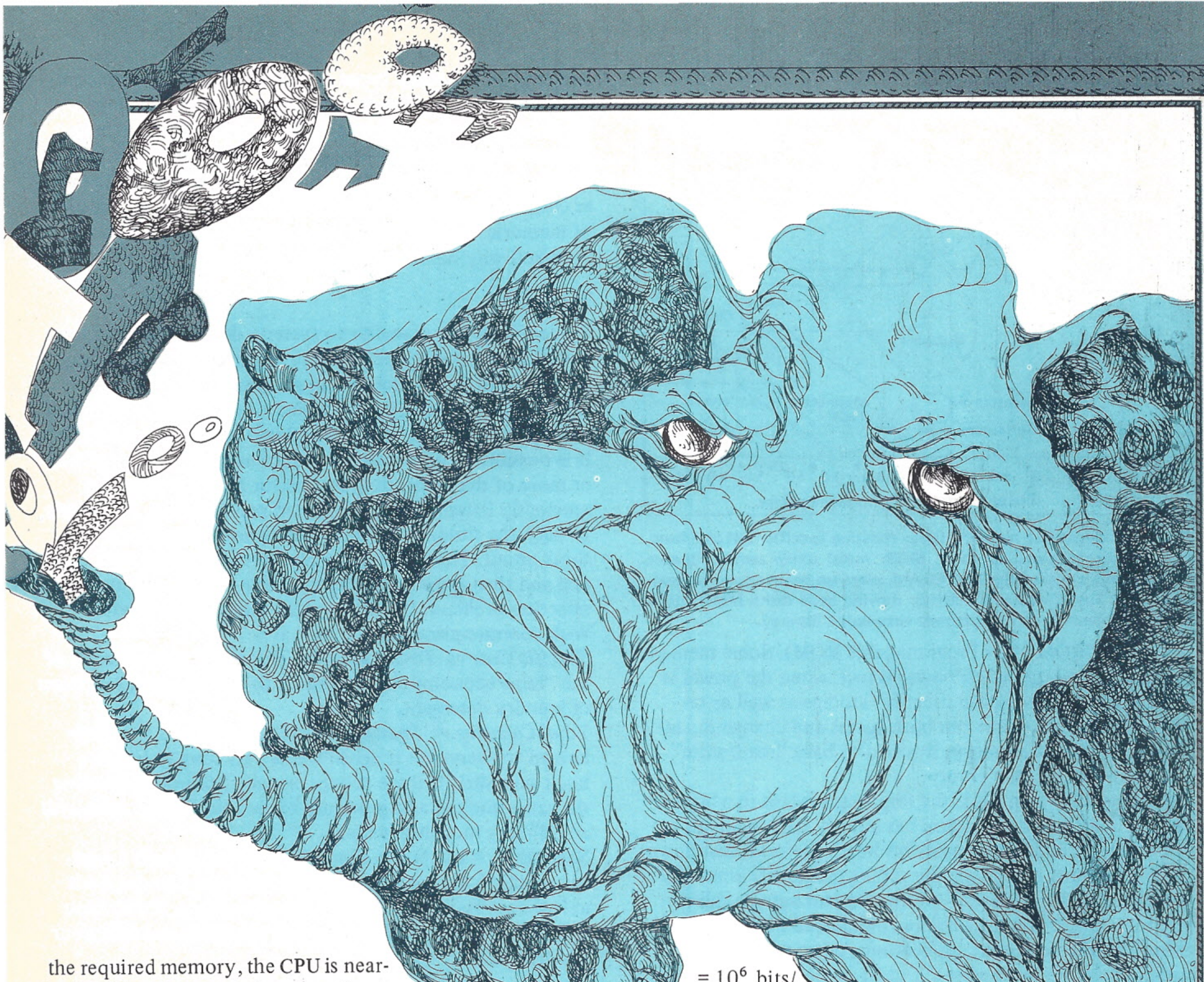
William A. Manly

Volatile? Bucket-brigade? Can I get an EBAM for my drum? Do I want one? The personal computer owner really has comparatively little choice in memory systems, but that situation is changing slowly. This straightforward tutorial discussion of computer memories takes most of the mystery out of memory jargon so that when you're ready to buy you can make sensible decisions.

The bottom has dropped out of the computer market, so this means that low cost computers are now available to the average fellow, right? Well . . . not completely right, but not exactly wrong, either. A lot depends on what is meant by "computer." It's true that central processor units, or CPU's, are now made on single chips, and the price is heading toward about \$10 for a general-purpose unit, but a CPU does not a computer make. A computer has a processing (or arithmetic) part; it can be given a series of instructions to carry out automatically (it's programmable); it can retain intermediate results; it can make simple decisions, and it can communicate with the outside world. All of these things imply that two other items besides the processing part are required: communications equipment and a memory.

Memory Is the Most

This article discusses memories only, since communications deserves an article of its own. Any CPU-on-a-chip (i.e., a CPU contained on one semiconductor chip in one small package) has some internal memory already. Without any outside assistance, it can usually remember enough to add or subtract two integers and hold the result. Sometimes this simple mathematics is good enough for the application. Usually, though, you would like to do something more complicated. Holding the program of instructions requires more memory and holding the results of intermediate calculations requires even more. And if the computer is to handle a sizeable amount of data, it needs still more. Suddenly, we are faced with a rather odd situation: compared to the cost of



the required memory, the CPU is nearly free! So what started as choosing a personal computer now requires us to become experts in the selection of memory since most of our money will be spent on that part of the computer. Where and how do we start? Usually, classifications help. So let's start there.

Computer Memory Selection: Controlling Factors

Four factors are important in computer memory selection:

- **Capacity**, usually given in bits, but sometimes in bytes or words. (A *bit*, an abbreviation for binary digit, is the smallest unit of digital information usually conveyed as either a "zero" or a "one." It can represent a voltage level, a switch position, the presence or absence of a pulse, a state of magnetization or a "yes" or "no." A byte is often considered to consist of 8 bits that as a unit can represent one character, two numerals or an 8 bit word.
- **Cost**, usually the specific cost (cost per bit).
- **Access Time**, more properly, specific access time. This is the (average) time required to find and retrieve one bit or one byte, or the interval between the insertion and completion of a specific amount of data storage in a computer memory device.
- **Data Transfer Rate**, given in bits per second or bytes per second. For some memories, data transfer rate is just the reciprocal of specific access time (i.e., for specific access time = 10^{-6} second/bit, data transfer rate = $1/10^{-6}$ = 10^6 bits/second), but for most other memories, the two have little relation to each other. Data transfer rate is independent of capacity, and relates to cost only for very high and very low rates. You can learn much by looking at the relations between capacity, cost and access time. We'll do that, shortly.

Secondary Factors

One problem with the previous list of factors is that it was formulated by engineers interested in very large computers and extremely massive memories. Some of these factors are generally the same at the smaller end of the scale, but other elements (which are secondary for large computers) may control the selection for small installations. Some are:

Volatility. Some memories are wiped clean if the power goes off. These are "volatile" memories. Of the ones which do not "forget," some are not programmable after the first time. These are called "read only memories," or ROM's. Some are re-programmable (but not by the computer) and

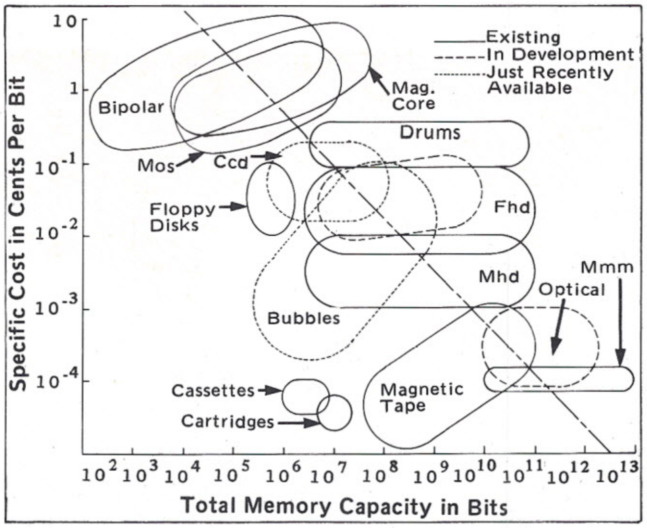


Figure 1. Computer memory types showing specific cost as a function of total memory capacity. MOS: metal oxide semiconductor. CCD: charge coupled devices. EBAM: electron beam accessed memory. FHD: fixed head disks. MHD: moving head disks. MMM: magnetic mass memory (magnetic tape automated library).

are called PROM's (for Programmable ROM). Some memories are not volatile when power is lost; when the power is on, the computer can use them for storage as well as retrieval. If the computer can both access and change the information on the memory, it is said to have "read/write" capability with that memory.

Total Cost. Cost per bit is the important factor in a large installation since the decision has already been made to get the memory, and low cost per bit keeps the total cost down. With a personal computer, the total expenditure is usually limited, and the computer will not be purchased at all if the total cost is too high. While commercial computers are selected to serve certain applications, personal computer applications are often selected to fit computers determined almost entirely on the basis of cost.

Access Mode. Random access is generally more useful for fast memories in small computers, because it requires the least hardware. For slower memories of larger capacity, serial access is much less expensive, and thus tends to be used in small installations. Random access means that the time required to retrieve the byte is independent of its position in the memory; the opposite is true of serial access.

Address Mode. Addresses of byte locations can be indirect, direct or indexed. Usually the CPU can handle the first two types, but indexed addressing requires additional hardware, increasing the cost. For instance, a CPU chip such as the 8080 has a 16-bit address capability. It can recall from memory a total of 2^{16} = 65,536 bytes which may be directly addressed (or indirectly addressed by a program). A byte in the 8080 is 8 bits long. A complete computer using the 8080 may have a word length of 8 bits, or it may use a longer word, usually some integral multiple of 8 bits long (16, 24, 32, etc., bits long). Information contained on a floppy disk (potentially far more than 65,536 bytes) is obtained through a controller which works with the computer to *index* and locate whatever is wanted. The least costly alternative is nearly always chosen in personal microcomputers, even though the performance may be compromised.

Computer Memory Hierarchy

"Hierarchy" is a term usually used to designate the "pecking order" in a large organization. It has been borrowed by the computer memory people to designate the organization and rank of the many types of memories used in large computers. The study of such organization is of prime importance to achieve overall cost-performance balance in large computer systems. It is also of great use in the study of memories for small computers. The study assists in the proper choice of memory elements by showing why certain types of memories are not likely to be used at all in small systems and why others will be very popular.

Tradeoffs

Tradeoffs are very familiar to systems designers and to some extent to the average person. For instance, you might want a large luxurious automobile and good gas mileage as well. Since you are not likely to obtain both with one automobile, you are faced with a tradeoff and its resulting compromise. It is possible to find tradeoff situations in any group of two or more of the controlling factors for memory selection previously listed. They are handled one at a time, if possible, to keep the situation from becoming too complicated to think about. Three tradeoff situations seem to be very general and thus approach universal use in almost any memory selection problem. We will explore these in some detail. With commonplace similes, they are:

Specific Cost vs. Total Capacity. This is the phenomenon of the "large economy size," familiar to any frequent purchaser of laundry detergent.

Total Capacity vs. Specific Access Time. This is also well-known to everyone: it doesn't take very long to locate a book on a shelf if there is only one shelf of books; locating the same book in a large library takes a lot longer, even with an efficient indexing system.

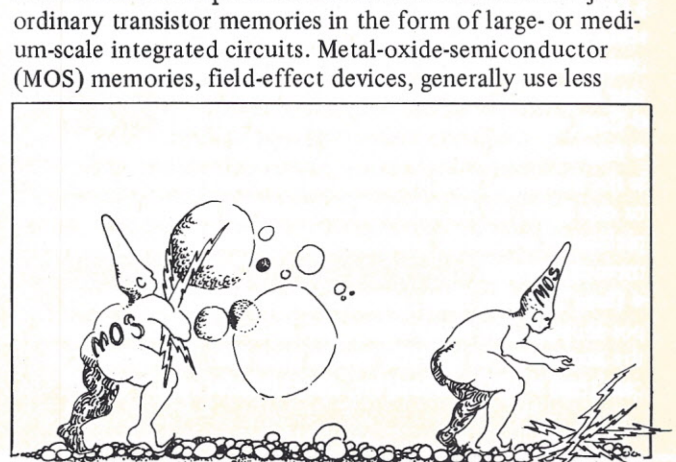
Specific Cost vs. Access Time. If you want to visit a number of places during your summer vacation, you can do it at low cost by bicycle if you have all summer; if you have only two weeks, you'll have to pay the price and take your trip by air.

Cost vs. Capacity

Fig 1 graphically illustrates cost vs. capacity tradeoffs. In general, overall tradeoff of cost vs. capacity follows (approximately) the long-and-short dashed diagonal line. Two memories in Fig 1, not yet available commercially, are shown in dashed lines: Charge-coupled devices and magnetic bubbles are now being delivered, but acceptance so far is small. These two memories are shown in dotted lines to indicate that their acceptance is just beginning.

The cost/capacity tradeoff cannot be made for some memories: they must always be made in large capacity to keep the specific cost down. The memories shown can be grouped into four general categories:

Semiconductor. Bipolar semiconductor memories are just ordinary transistor memories in the form of large- or medium-scale integrated circuits. Metal-oxide-semiconductor (MOS) memories, field-effect devices, generally use less



power than bipolar memories. These low-capacity, high cost memories are both volatile and both are used by small computers. Their data transfer rate, approximately the reciprocal of their bit access time, ranges from 10^6 to 10^7 bits/s (bits per second).

Charge Storage. The charge-coupled devices (CCD's) are "bucket-brigade" type MOS devices which move a small quantity of electrical charge from one discrete location to another. A whole string of charges is moved at once: whence the "bucket-brigade" designation. The electron-beam-accessed memory (EBAM) employs an unstructured MOS chip on which electrical charge "lumps" can be stored with an electron beam. The presence or absence of a charge can be determined by beaming a stream of electrons on the location. Charges can also be manipulated by the electron beam, aided by external biasing circuitry. Both these devices could also be designated as semiconductor memories, but are placed here in a separate category, since they operate differently from the "semiconductor" category. The EBAM (General Electric calls its memory "BEAMOS") is non-volatile, while the CCD is volatile. CCD's are available in a form useful in small computers, but engineering samples are just now being delivered. Data transfer rates will be in the order of 10^6 bits/s for CCD's and up to 10^7 bits/s for the EBAM. The lower capacity limit for a commercially feasible EBAM is about 3×10^7 bits. Because a precision electron gun and its power supply are expensive, to keep EBAM specific cost low, it must be able to store at least that many bits.

Optical. Some optical memories are available, but they are read-only and not popular. The printed page is actually an optically-read memory, but its storage density (bits per cubic centimeter for volumes, or per square centimeter for surfaces) is not very great. Most optical memories have high storage densities and are made by several methods: ordinary photographic; evaporation or etching of metal films by laser or electron beam; making local changes in materials by heating with laser or electron beam; or by making changes in materials with high energy photons in a laser beam. The changes may be magnetic, electrical, plastic, elastic or chemical. It is not likely that these memories will be used for personal computers. To be commercially feasible, only optical memories of above 10^{10} bits are ever considered. The same reasoning applied to the EBAM applies here: the precision optical system is very expensive. Optical memories all have data transfer rates above 10^6 bits/s, and one type has a potential of going above 10^{11} bits/s. Future devices will have read/write capabilities. Optical memories are non-volatile.

Magnetic. This is the largest category and it has several sub-categories.

Magnetic Cores. These store information via the magnetization of toroidal (doughnut-shaped) ferrite cores. Cores contain only one bit of information per core. The information density is not great, since the cores are large enough to be seen by the unaided eye, a factor causing them to lose ground to the semiconductor memories with which they compete. Data transfer rates are on the order of 10^6 bits/s. They are non-volatile, an advantage in many applications. They are usable in small computers but few personal computers use them because they require more space and need drive and read circuitry. Such small core memories cost too much per bit.

Magnetic Bubbles. Bell Telephone has high hopes for this technology, and now uses it in some switching circuits. Texas Instruments was the first to introduce a commercial unit for office application. Bubble memories will certainly be used in small computers. TI has announced plans to put them in small calculators. Its current models for small business systems range from $2700 to $3000.

Table I Function	Word size in Bits	Number of Words	Total No. of Bits
Print cradle communication	13	400	5200
Programming accommodations	13	500	6500
Pending operands (including 9 levels of parentheses)	64	11	704
Data registers	64	20	1280
Programming steps	8	224	1792
Keyboard functions	13	2000	26000
Total			41476

Table 1. Memory uses and sizes in the Texas Instruments SR-52 calculator.

Magnetic bubbles are formed in thin sheets of certain magnetic oxides. Bubbles are shaped by applying a biasing magnetic field perpendicular to the plane of the sheet. Each bubble is a single wall domain in the shape of a right circular cylinder in the sheet. These domains can be moved from point to point in the two dimensional film structure. (The film is laid down with certain preferred locations for the "bubble" domains). Their presence, absence or sense of magnetic direction at any location can be used to store information. It is almost certain that bubbles will be used on all sizes of computers. Bubble memories transfer data at rates up to 10^6 bits/s. They are non-volatile, but accessed serially (in order, one-at-a-time), so an index must be created to retrieve the information.

Moving head-surface (or surface-head). These memories come under the term "magnetic recording" and consist of a ferromagnetic surface prepared in such a way that magnetic domains *cannot* move around (in contrast to bubbles). An inductive head – essentially a toroidal core wound with a coil or coils of wire and containing a gap from which flux leaks into or out of the core – is used to write on the magnetic surface or read information from it. Magnetic recording is essentially binary in nature, but the number of domains coupled to the head at any time is so large that multi-level analog signals can be recorded in a statistical fashion with signal-to-noise ratios as high as 1000 (as in high-quality sound recording). Magnetic recording systems fall into two broad classifications: linear, and rotating.

Linear recording is magnetic tape recording with tapes wound on reels or in cassettes or cartridges. Half-inch tape drives transfer data at up to 6×10^6 bits/s; cartridge drives transfer data at about 5×10^4 bits/s and cassettes at 8000 bits/s or less.

Rotating magnetic recording includes drums, rigid disks with either fixed heads and one head per track (FHD) or moving heads with one head per disk (MHD). Drums usually have fixed heads and one head per track. The newest type of disk is the flexible disk or "Diskette" (TM, IBM) which is often called a "floppy disk", or just "floppy", now produced in two sizes. Rigid disks and drums may have data transfer rates as high as 10^7 bits/s, while floppies transfer data at rates from 2.5×10^5 bits/s to ten times that rate.

Magnetic recording systems, especially tape systems, tend to be the lowest in specific cost and highest in capacity. Their use is nearly ubiquitous. The magnetic mass memories (MMM) are specialized magnetic tape systems in which the selection of the tape container is indexed and handled under computer control, with no human assistance.

Capacity vs. Access Time

Fig 2 shows you why expensive memories like bipolar, MOS and magnetic cores are used: they are very fast. Computers have voracious feeding habits, especially large computers which are faster than the fastest memories presently available. There is at least one memory with the possibility of speed faster than any computer, but it is not on the chart since it is not yet out of the research stage. It is the "Josephson Junction" device which must be kept at liquid helium temperatures for proper operation. Access time for this memory could be as low as 10^{-11} second.

Another discovery can be made from Fig 2. It highlights why such vigorous development work is being done on EBAM, CCD and bubbles. They fill the well-known "memory gap" between magnetic recording and magnetic cores. This gap causes some large computers to operate inefficiently, since they must wait a long time for retrieval of information from magnetic recording devices. EBAM looks particularly good; its access time is fast for its large capacity.

It is not really clear from Figs 1 and 2 why anyone would choose to use floppy disks because their specific cost is not as low as that of the cassettes and cartridges. Note that they fill in a small access time gap in Fig 2. Also remember that their transfer rate is much higher than either cassettes or cartridges. Last, they are relatively low in capacity, making them low in total cost. These factors make them attractive for small systems needing their moderately high transfer rate. Cassettes have the lowest cost per bit of all the memory systems but the poorest performance.

Personal computers usually have only a two-step memory hierarchy, and are not so concerned with a memory gap as the largest systems; but the hierarchy and the gaps are still meaningful. Using a cassette in certain tasks will noticeably slow all but the very slowest computers. At the other end of the scale, bubble memories are fast enough to keep up with many microcomputers and will afford the capability of a much larger memory at a much lower cost than semiconductor memories. Bubble memories will quickly be assimilated by personal computers.

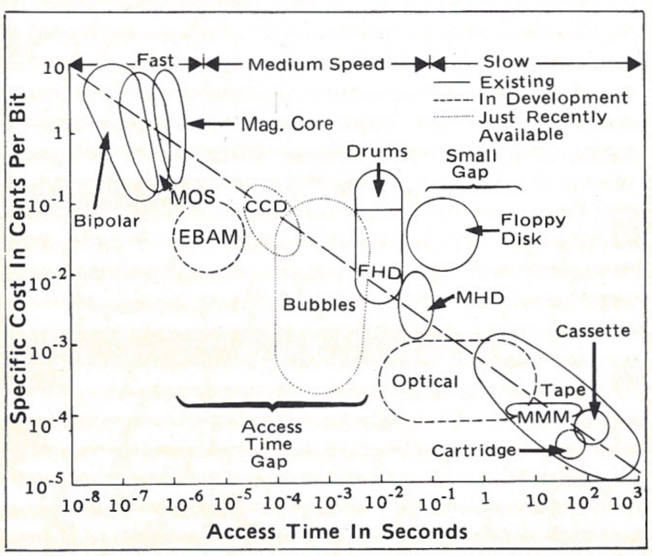


Figure 2. Specific cost as a function of access time for different types of computer memories. Abbreviations the same as for Figure 1.

Note the new addition in Fig 3, that of the human brain. We cannot yet interface a computer directly to it, but must go through painfully slow communication transducers. This device could not be entered on Fig 1; I haven't the slightest idea how to obtain specific cost figures for it. Comparison with the other memories of similar capacity in Fig 1 gives an estimated specific cost of 10^{-3} to 10^{-4} cents per bit; that figure indicates that it should be worth from 1 to 10 million dollars. Most of this, of course, is programming cost, as unprogrammed devices are in oversupply. The access time is highly variable. I show access time as less than a second, but this is under highly favorable conditions. My own device has occasionally shown access times ranging up to 10^5 seconds (a day), and it sometimes loses information entirely. The data transfer rate, limited by the intercommunication transducers, is typically about 400 bits/s for input (reading at 500 words per minute), and about 200 bits/s for output (talking at 250 words per minute). This type of memory is not only volatile, but is severely damaged if the energy source is removed for more than five minutes. It is normally random access, but can be shifted into serial access if the occasion requires. It uses a very peculiar type of address called *associative,* which no one understands at all (It seems probable that understanding of this address mode is essential if we are ever to construct a computer that can think). These memories may not be here to stay; there are just too many problems with them.

Optical memories also fill in the small access time gap between magnetic tape and rotating magnetic memories. Floppy discs, cartridges and cassettes are obviously (from this diagram) the bulk storage media to use for small systems with memory requirements less than about 10^7 bits storage. Fast access systems use bipolar, MOS and core memories. CCD and bubble memories in personal computers are a distinct possibility, but EBAM, drums, optical and MMM are too large to ever find their way into small systems. Fig 2 shows how we pay for short access time. Anything below the heavy dash-dot line is less expensive than average for its access time. EBAM, bubbles and optical are the outstanding memories in this category. Of the three, bubble memory is the only one likely to be used for small computers. The moral to the heading of this paragraph is that one should not design for a shorter access time than one really needs since it will cost dearly.

Two access gaps are also clearly visible in Fig 3. One or two predictions are appropriate here: If magnetic bubbles become available in a wide range of capacities, they will become very stiff competition for the CCD's. EBAM has to be large, and thus will compete for only the largest computer. Optical memories and floppies are not competitors, because there is such a large difference in capacity. Floppies will exist only where relatively high transfer rate is required, unless the specific cost comes down (either by reducing the cost, raising the total capacity, or both). A specific cost of an order of magnitude lower would make floppies a competitive type of magnetic recording, but they are not likely to get that low, because something must pay for the higher transfer rate. Right now, floppies don't look all that good for personal systems unless you have enough cash to "gild the lily". The mini-floppy does seem to be a step in the right direction.

One last observation on Fig 3: note the three categorical speeds of memories – fast (semiconductor type); medium speed (disk type); and slow (tape type).

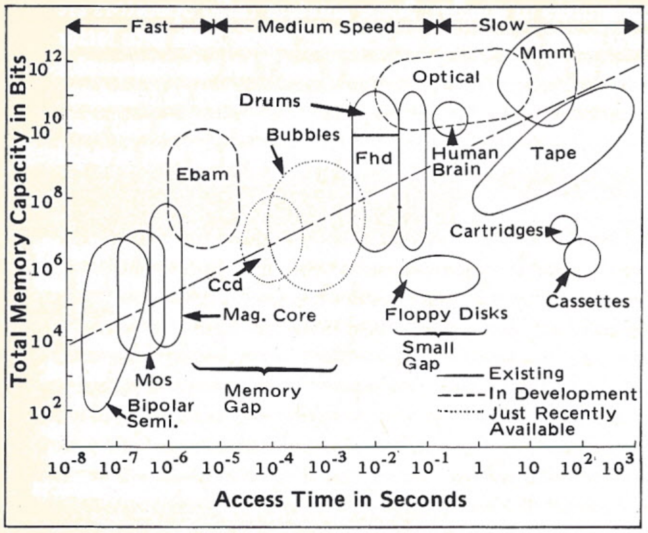


Figure 3. Memory capacity of various types of computer memories as a function of access time. Abbreviations the same as in Figure 1.

Practical Selection of a Memory

The practical selection of a memory depends on four main factors. They are listed more or less in order of importance, though the last one may veto or substantially alter any previous selections made. The four factors are:

1. Type of computing job or combination of jobs to be done.
2. Necessity for and type of interface devices between the CPU and the memory.
3. Time allowed (or desired) to do the job vs time required with any particular memory combination.
4. Total money available for the system vs the total cost of the proposed system. If this is out of balance, go back to 1 and start over.

Computers at Work

Anyone who makes up a list of possible occupations for computers will come up with a list a bit different from anyone else's. Here is one list: Scientific, engineering, and statistical calculations; Business (accounting, inventory, payroll); Control of devices and processes; Communications; Games; Data gathering and storage; Data manipulation (storage optimization and sorting; Word processing; and Plotting and graphics. All these applications require different amounts and types of memory, and we will examine these uses one at a time.

A Computer in Your Pocket

Let's first look at the simplest "computers" useful for scientific, engineering and statistical calculations. Such programmable calculators as the Texas Instruments SR-52 fit the definition of a computer given in the first paragraph of this article. Since calculators do not convert their numbers into pure binary (binary is the representation of numbers in the base 2 system) as do most general purpose computers, comparing their memory to that used with a microcomputer chip is not straightforward, and the results are good only to a first approximation. Such a comparison is instructional, and the results are surprising. One of the engineers who worked on the design of the SR-52 provided the information outlined here.

The SR-52 generally uses 13-bit instruction words and carries the data in 16 digit registers (decimal digits). The coding is binary coded decimal (BCD), which uses 4 binary bits per decimal digit, so they use 64 bits per data register. Table I gives the breakdown. This total number of data bits is remarkable in a computer now available for less than $200, and TI has just upstaged the SR-52 with a new machine having several times the memory at less than $300 cost.

Many CPU chips now have some memory: several data registers and a number of internal instructions. To compare the calculator memory with that of a microcomputer with an 8-bit size, divide by 41,476 (from Table I) by 8 to get slightly less than 5200 bytes. Subtracting a few bytes to account for the internal memory already in a microcomputer chip makes it roughly equivalent to a CPU chip with about 4 kilobytes of memory. This compares favorably with a "minimum" microcomputer available from several manufacturers: e.g., the Altair 8800 can handle a simple form of BASIC on 4K bytes of memory (but not much program). Simple computers such as these can handle calculations with one or two variables. Calculations with many variables, such as electronic circuit analysis, mechanical structure analysis, statistics of multivariable systems and the like require the manipulation of large arrays of numbers (matrices) that use hundreds of kilobytes of main memory.

Engineering and scientific computers may use medium speed memories for time-sharing among several users. Some computers keep their operating instructions on such memories; otherwise, not much medium speed memory is needed. Low speed memories are used to store data and programs, so we can characterize a typical scientific-engineering-statistical computer as one that requires a large fast memory, some medium speed memory and a medium amount of slow memory. The fast memory is sometimes called "main memory," because it is accessed by the CPU.

Compilers and Interpreters

To digress briefly on an important point, note that a computer programmed in machine language (or calculator language for calculators) requires a lot less fast memory than one which has to **compile** the instructions from a high level language such as FORTRAN or COBOL. **Interpreting** a language such as BASIC or APL doesn't require quite so much fast memory as compiling, but does require substantially more than machine language programming. In effect, a compiler is another program which translates the program written in high level language into a machine language program which is stored in the fast memory until it is run. An interpreter translates the high level language, one instruction at a time, into a group of machine language instructions which are immediately executed. The interpreted program is not stored. Any computer with a compiler or interpreter will have at least a medium size fast memory. Subsequently, in this article the part of the fast memory devoted to compilers and interpreters will be ignored, and remarks will be addressed only to the amount of memory needed to hold and run the machine language program.

TABLE II

Size Category	Fast Memory	Medium Speed Memory	Slow Speed Memory	
Small	To 4k	To 10^6	To 10^7	bits
Medium	4-32k	10^6-10^8	10^7-10^9	bits
Large	32-256k	10^8-10^{10}	10^9-10^{11}	bits
Extremely large	Above 256k	Above 10^{10}	Above 10^{11}	bits

Table II. Quantitative definitions of memory sizes for the three basic memory speeds.

I have used some non-quantitative adjectives such as "large", and "small" to describe the size of memories. These words are poor quantifiers; they mean different numbers of bits when they are applied to fast, medium and slow speed memories. Table II is a somewhat arbitrary quantification for these adjectives as a function of memory speed. These definitions will continue to be used in this article.

Words on Bits and Bytes

Be careful that you understand what people mean when they write or say things like "4K of memory". They could be referring to bits, bytes or words, and the size of the memory is progressively larger for the latter terms. For instance, one well-known computer based on the 8080 CPU chip has a byte length of 8 bits. It can handle numbers of word length 16 bits, 32 bits or 64 bits. The longer words represent numbers of greater precision than the shorter words. 4K words (actually 4096) of 64 bits length give 262,144 bits total, or 32,768 bytes – half the total that the 8080 can directly access. This is a lot different from 4096 bits, which is only 512 bytes. The numbers will dazzle you if you're not careful; ad writers are well aware of this fact. Now, back to the tabulation of computer occupations.

Give it the Business

Business computers require remarkably little fast memory, and the amount of medium speed memory they use depends upon how efficient they have to be. They tend not to have medium speed memory (except for operating system instructions on some), and may be fed by a really slow input such as a card reader or even a keyboard. We discussed none of these techniques, because they are input devices and not memories. Business computers for small companies often have excess capacity, and operate only part of the time. Business computers for large companies operate all the time. They have to be more efficient, so they have medium and slow speed memories in medium to large capacity but still not much fast memory.

Computer Your Control

Computers used for control cannot have slow memory. Complex control systems may have some medium speed memory, but usually, control computers have small to medium size fast memory.

Computers used for communications are usually minicomputers or smaller. Some amateur radio operators are now using computers to translate Morse code into letter copy or to translate between 5 and 7 bit telecommunications codes. Western Union uses computers to translate messages from the TWX to the TELEX system and vice versa. A small amount of fast memory is all that is required.

Computers at Play

A computer used for games is nearly impossible to classify. At the low end, a great deal of work has been done on the use of 4-bit microprocessors with 1 or 2 K bytes of memory as a consumer-type "electronic (or TV) game" now on the market. The input device is a small keyboard; the output device is usually a TV set. Some versions of "Star Trek" require 64 K bytes of fast memory. I can envision, as well, "space war" type games using a good deal of medium speed memory for such things as sound effects and voice synthesis.

At MIT a LIFE game uses over 10^6 bits of fast memory just for display, not to mention the control program. Games do place an emphasis on fast memory, with possibly some requirement for medium speed memory. The more complicated game requires more memory, with only the very largest, fast memories having the ability to do things like playing championship quality chess.

Electronic Pigeonholes

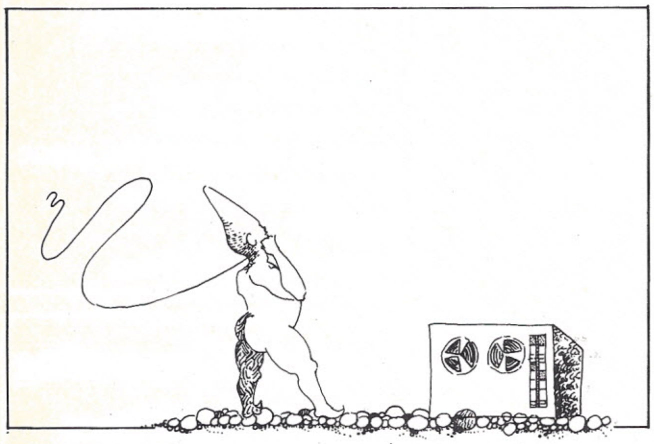
Data gathering and storage activities usually use only a small amount of fast memory, with the computer storing the data in a small, slow memory. Medium speed memory might be used but probably not. Data manipulation is something else. Here, the data is already in storage and must be rearranged, with redundancies eliminated, for more efficient storage. Sorting of lists and finding of specific information in large blocks of data is a task which requires a low speed storage bank of large to extremely large size. A medium to large size medium speed memory might also be used, depending on the data and how fast it must be retrieved for use. There are techniques for sorting long lists without using a lot of fast memory, but such memory makes the job more efficient. Computers to handle this type of job are usually the largest, with the largest memory banks anywhere. Because of the usefulness of such a computer to military and intelligence operations, the U.S. Government has placed an embargo to nations in the Soviet Bloc on the sale of computers with this large amount of medium speed memory.

TABLE III Computer Use	Fast Speed	Medium Speed	Slow Speed
Scientific, engineering, statistical	large	small	medium
Business (accounting inventory, payroll)	small	medium-large	medium-large
Control of devices and processes	small-medium	small	none
Communications	small	none	none
Games	small-extr. large	none-medium	none-small
Data gathering and storage	small	none-small	small
Word processing	small-medium	none-small	none-medium
Plotting and graphics	small	none-medium	none-medium

Table III. Summary of memory size requirements for various uses of computers.

My Word!

Word processing is an application that doesn't usually require much of a computer at all. A lot of the word processing machines go by such names as "Magnetic Card Typewriters", "Editing Typewriters" and the like. Businessmen find that these machines will save time and money in the preparation of correspondence and reports. Without such a machine, letters and reports are sometimes typed four or five times before the final draft is sent out. With a word processor, only the first draft and subsequent additions or changes need be typed by hand. The machine will handle all editing semi-automatically and re-type it as needed. The fast memory for a word processor is usually small. It does need a small amount of medium speed memory to hold the rules for justifying, paging, etc. A floppy disk setup would be ideal, but most often the rules are placed in a read-only fast memory, making the fast memory medium sized and



the medium speed memory nonexistent..

The amount of slow memory required depends upon the size and number of documents to be handled. A yardstick for the size required is that the Bible (Old and New Testaments) contains about 10^6 words, which can be contained in a memory of about 5×10^7 bits. A typical business letter can be handled in a memory of about 1K bits. Word processing might be an interesting field for an amateur to try.

There's a Plot Here Somewhere

Plotting and graphics are used most often in conjunction with scientific, engineering and statistical calculations, but are different enough to warrant separate treatment. Plotting can be done in several ways. One is with a TV raster or similar scanning device. A great deal of plotting has been done on plain old Teletype machines. A line printer could be used as well. Other plotters move pens over paper in patterns under digital, x-y, control. Not much memory is required in any case, unless all the calculations are done beforehand and the points are read out of the memory into the plotting device. The memory required is a medium amount of slow speed memory, but the data transfer rate must be high enough if a scanner is used. Simple graphs are in the province of the amateur computist, while such things as printing the pictures returned from planetary exploring spacecraft require large, medium or slow speed memories.

I hope that I have given you a meaningful overview of computer memories. I also trust that now you can make an intelligent choice of memories for your system. Lastly, I'd like to think that I have also piqued your interest in trying some things with your computer that you otherwise might not have thought of doing. PC

Classifieds

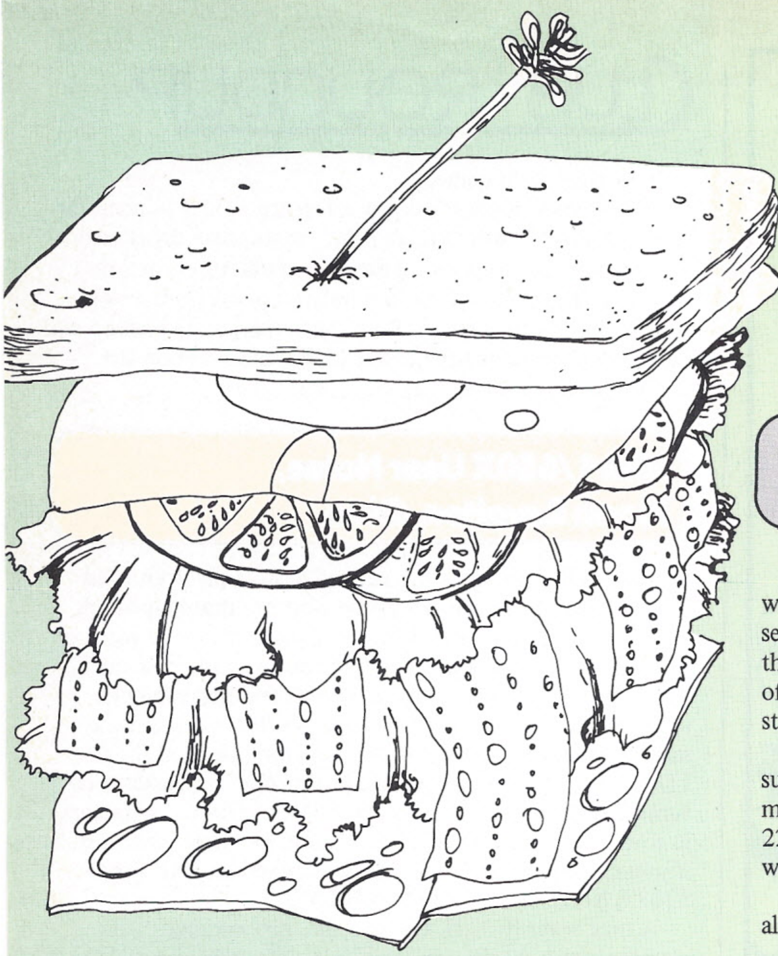
Personal Computing Classified Rates

Individual: $1 per word; address set free; first two words set in all capital letters for free. If you want **bold** type, add $1 for each word set bold. Add $5 if you want replies sent to us and forwarded to you.

Company: 1X: $60/inch; 3X: $55/inch; 6X: $50/inch. Display ads accepted only if camera-ready materials submitted. Agency commission paid on camera-ready ads and after the first insertion of a publisher-set ad if subsequent insertions run without changes. Publisher sets ads in format and attempts to fit copy into space requested.

Advertisement accepted, however, with understanding that space may be larger than requested. Minimum billing size one inch; ads billed in half-inch increments thereafter. Frequency rate applies to publisher-set ads only if they run without changes in subsequent issues.

To place an ad, send your copy to Classified Ad Dept., **Personal Computing,** *167 Corey Rd., Brookline, MA 02146.*



Calumet Computer Tribe, Hammond, Indiana: RANDOM NOISE

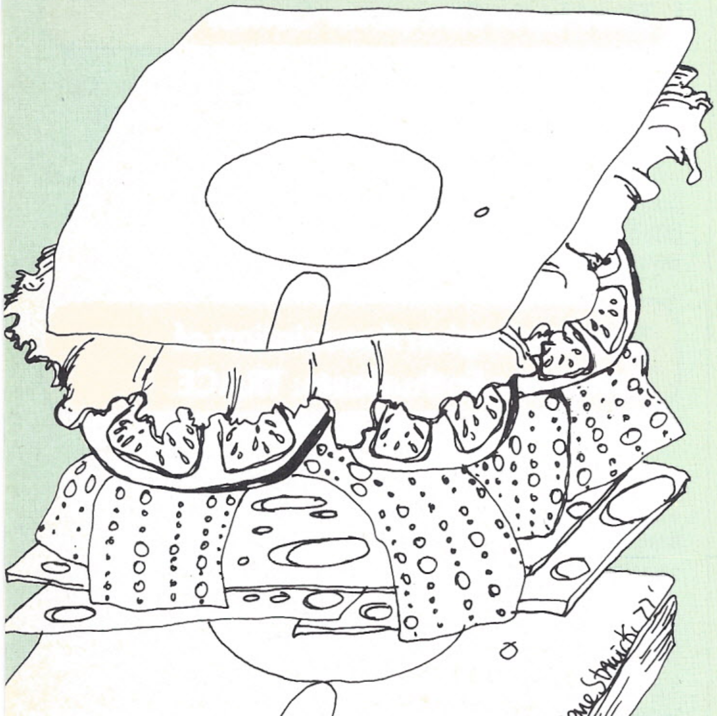
There's much ado about the fast-changing microcomputer world at Tribe meetings – members produce interesting presentations by arriving with systems in hand to demonstrate their experiments in fellowship. Members agree the success of each meeting lies in real-life application, testing and instruction primarily in the area of entrepreneur efforts.

The CCT is a club serving northwestern Indiana and south suburban Chicago area, meeting the first Sunday of each month. Organized this past March, the club has grown from 22 to 80 members who have become affiliated with the Midwest Alliance of Computer Clubs (MACC).

Interested? Dues are $5.00 annually – meetings open to all.

CLUB ROUNDUP

by Louise Garcia



HEATHKIT Users Group, New Haven, Connecticut: BUSS

In an effort to find an official name for this newsletter editor Charles Floto is running a contest – the entrant who provides the best title receives a five-year membership to the Club. Entries must not include the Company's trademarks such as "Heath" or "Heathkit."

Floto renders some tips on various Heath products including some illustrations and photos. Write to him, 267 Willow Street, New Haven, Connecticut, mention Personal Computing, and he'll send you a free copy of "BUSS".

National Association of Independent Computer Companies: NAICC Review

Now here's a newsletter that's as fit to read as a top ten novel. Chock full of info from new products and new appointments to manufacturing contacts and mailing list offers – even a few hints on living a healthier, longer life. A recent edition carried a handy guide put out by the Bureau of Labor Statistics providing a cost of living index for major U.S. cities. Using it can help you in deciding where to move

to improve your income.

The Review published a few reference points to manufacturers in the #9 edition in an effort to improve distributor support and relationships between manufacturers and distributors. The points, four in number, are: Train the sales staff, maintain field support, establish marketing backup and liaison (a communicating council). For clarification the author gives examples of each.

KIM-1/650X User Notes, North Royalton, Ohio

Charles R. Carpenter has penned a short piece entitled "Paper Wasters" which is a bit on routines that help teach KIM-1 programmers about the machine and uses of some of the monitor subroutines. The first routine will get a character from the TTY keyboard, display it and print the hex value for the character. The second routine will print the same info, but only if the valid data could be used for the LDA value. By selectively using spaces (1E9E), carriage returns (1E2F) and characters (1EAO) a matrix of characters in rows and columns can be generated. Let User Notes know if you come up with any other combinations, P.O. Box 33077, North Royalton, Ohio 44133.

A time saver by C.H. Gould illustrates a simple cycle counter which displays in hexidecimal form the cycle (microsecond) length of a program or segment thereof. The segment cannot be longer than 256 cycles. Write starting address of program segment at 17C8 (LO) and 17C9 (HI). After last step in program segment to be tested, write 4C CA 17. Start at 17C0 and read cycle time on low bits of address display.

The Marin Computer Center

A project of the Ulenar Corporation in Mill Valley, California invites Personal Computing readers who are SOL users to contact them. They're looking for users who are willing to make their SOL-compatible software available to other SOL users around the country. Royalty rates can be established. Write to Annie Fox at Ulenar, 236 Almonte Boulevard, Mill Valley, California 94941, 415-388-1294.

Toronto Region Association of Computer Enthusiasts: TRACE

Newsletter #17 tells the story of BASIC – how it was developed, by whom, and why. Author Ross Cooling writes about all the commands one comes across in a 4K BASIC and 8K BASIC. "Learning Basic" covers the commands by starting at the beginning and builds upon each so that you're capable of writing a program at the conclusion of the three-part series. This comprehensive article includes BASIC variations and definitions of fundamental jargon used to get a system up and running. Cooling sorts out math operations guiding the computerist in the use of variables and strings. PART II promises to cover functions in BASIC and PART III will be I/O – how to go through a program from start to finish.

If your system is plagued by excess heat – that one waspish part that burns up just for spite – read Ted Van Ryn's piece (Newsletter※13). In "Practical Heat Transfer" you'll discover innovative remedies to hot heatsinks – formulas that decrease thermal resistance of heatsinks by as much as three times. Along with some graphics, the author includes a few guidelines to follow:

1. Avoid pressure loss through air filters, probably the largest single cause.
2. Intake versus outlet – and he describes how.
3. Components sensitive to high temperature should be located in the coolest part of the air stream – and he tells where.
4. Direction in which components are mounted in the air stream – and he gives wherefores.

TRACE is the monthly newsletter of the Tornoto Region Association of Computer Enthusiasts, P.O. Box 545, Streetsville, Ontarios L5M 2C1. Subscriptions are $5.00 per year.

Journal of the Central Texas Computer Association "Print-Out"

"String Processing, Anyone?" Daniel Chester declares the need for a high-level language for non-numerical computing on microcomputers. He describes the STring Language (STL) intended to render some of the power of languages like LISP and SNOBOL, and does it in so smooth a manner as to be easily implemented on a microcomputer. Although STL is useful for many applications, Chester decides that the memory size will limit what one can do in the way of a theorem prover, for example, but STL at least allows you the possibility of starting to build one.

Print-Out, published monthly by the Central Texas Computer Association, 508 Blueberry Hill, Austin, Texas 78745. Subscriptions for non-members is $6.50 per year.

San Diego Computer Society, "Personal Systems"

Subscribers are provided an annual cummulative index to articles published during the year in the Club's newsletter. Included are subject titles, authors, issue date, page numbers, book review index – all in alphabetical order. A tidy, handy reference.

Pseudocoding! It's language and machine independent, meant to be understood by the programmer, not the computer. That's important to us who are working alone for the most part. The coding is a series of simple sentences fixed in a simple logical structure.

Author of "Pseudocoding in Structured Programming" Dick Lindberg says "It is not meant to be the only way to code, but rather a starting point from which you can develop your own method." In his illustration Lindberg indicates proper line indentation and sorting methods. He contends that, "if you code carefully from *one pseudocode line at a time,* it is entirely possible that the finished product will work the *first* time and *never* have a bug.

SDCS membership fees are $10.00 per year. For more information, write San Diego Computer Society, P.O. Box 9988, San Diego, California 92109.

Share your club's activities and accomplishments with us; send a copy of your newsletter to: Russ Walter, Personal Computing Magazine, 1050 Commonwealth Ave., Boston, MA 02215.

TRIPLE SAVINGS!

(LIMITED TIME OFFER)

- 20% OFF ANY GROUP/3 EDUCATIONAL PRODUCT THIS MONTH
- FREE ATTACHE CASE AND RECORDER WHEN YOU ORDER ALL 4
- SAVE TIME AND INCREASE EFFICIENCIES IN YOUR SHOP

SOMETHING FOR EVERYONE! GROUP/3'S COMPLETE LINE OF DP EDUCATIONAL PRODUCTS COVERS ALL LEVELS OF COMPUTER USAGE AND MANAGEMENT — EVEN END USERS. EACH COURSE CONTAINS AUDIO CASSETTE INSTRUCTIONAL TAPES, WORKBOOKS, VISUALS AND REFERENCE MATERIAL.

CCM — COMPUTER CONCEPTS FOR MANAGEMENT — TEACHES THE BASIC FUNDAMENTALS ABOUT COMPUTERS IN NON-TECHNICAL LANGUAGE FOR TOP MANAGEMENT AND LINE MANAGEMENT.

DUOS — DEVELOPING USER ORIENTED SYSTEMS — PROVEN SYSTEMS DEVELOPMENT METHOD—PROJECT PLANNING AND CONTROL—DOCUMENTATION AND AUDIT PROCEDURES—BASIC STANDARDS AND PROCEDURES—ORIENTATION AND TRAINING GUIDE.

RPG-TOP — RPG II TECHNIQUES OF PROGRAMMING — BEGINNING RPG II FOR THOSE WHO WISH TO LEARN RPG II AS THEIR FIRST PROGRAMMING LANGUAGE OR WISH TO ADD IT TO THE LANGUAGE THEY ALREADY KNOW. PRE-REQUISITE FOR ADV-30.

ADV-30 — ADVANCED RPG II & ARRAY PROCESSING — SAVES 30-50% IN PROGRAMMING TIME—ADVANCED RPG II TRAINING WHICH COVERS LOOK AHEAD, EXCPT, FORCE, READ AND ARRAY PROCESSING.

Rush Order Form or CALL NOW TOLL FREE (800) 423-5148 – In California, Call (213) 884-6678 Collect

PLEASE CHECK ONE OR MORE OF THE FOLLOWING:

- ☐ I'M TAKING ADVANTAGE OF THE 20% SAVING— PLEASE SEND ALL 4 PRODUCTS PLUS MY FREE ATTACHE CASE AND CASSETTE PLAYER/RECORDER
  TOTAL PRICE: $516.00 . . . . $ ______
- ☐ CCM – $120.00 (REGULARLY $150.00). . . . . $ ______
- ☐ DUOS – $140.00 (REGULARLY $175.00) . . . . $ ______
- ☐ RPG-TOP – $156.00 (REGULARLY $195.00) . . . . . . $ ______
- ☐ ADV-30 – $100.00 (REGULARLY $125.00) . . . . . . $ ______

$3.00 Handling Charge (Omit if check is included) . . . . $ ______

Calif. Residents add 6% Sales Tax. . . . . $ ______

TOTAL . . . . $ ______

☐ PLEASE SEND FREE GROUP/3 PRODUCTS CATALOG

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

COMPANY		
NAME	TITLE	
ADDRESS		
CITY	STATE	ZIP
PHONE	PURCHASE ORDER NO.	
SIGNATURE		PC

® GROUP/3 and Informatics are Registered U.S. Trademarks

GROUP/3

GROUP 3 is a part of Informatics Inc., the worlc largest independent supplier of software produc

P.O. Box 1452

21050 Vanowen Street Canoga Park, CA 91304

ADVERTISERS' INDEX

SALES OFFICES

Northeast: George Palken, 1050 Commonwealth Ave., Boston, MA 02215; (617) 232-5470; • **Mid-Atlantic:** Arthur Daks, Benwill Publishing Corp., 299 Madison Ave., N.Y., N.Y. 10017; (212) 661-0360 • **Mid-West:** Ralph Petersen, 1 Wheaton Ctr. No. 1706, Wheaton, IL 60187; (312) 653-2480 • **Southwest:** David Bunnell, 401 Louisiana, S.E. No. G, Albuquerque, NM 87108; (505) 266-1173 • **West:** Yuri Spiro & Carol Stagg, 823 Enchanted Way, Pacific Palisades, CA 90272; (213) 454-0624.

See Sol here...

ARIZONA

Byte Shop Tempe
813 N. Scottsdale Rd.
Tempe, AZ 85281
(602) 894-1129

Byte Shop Phoenix
12654 N. 28th Dr.
Phoenix, AZ 85029
(602) 942-7300

Byte Shop Tucson
2612 E. Broadway
Tucson, AZ 85716
(602) 327-4579

CALIFORNIA

The Byte Shop
1514 University Ave.
Berkeley, CA 94703
(415) 845-6366

Computer Center
1913 Harbor Blvd.
Costa Mesa, CA 92627
(714) 646-0221

DCI Computer Systems
4670 N. El Capitan
Fresno, CA 93711
(209) 266-9566

The Byte Shop
1122 "B" Street
Hayward, CA 94541
(415) 537-2983

The Byte Shop
16508 Hawthorne Blvd.
Lawndale, CA 90260
(213) 371-2421

The Computer Mart
633-B West Katella
Orange, CA 92667
(714) 633-1222

Byte Shop
496 South Lake Ave.
Pasadena, CA 91101
(213) 684-3311

Micro-Computer
Application Systems
2322 Capitol Avenue
Sacramento, CA 95816
(916) 443-4944

The Computer Store
of San Francisco
1093 Mission Street
San Francisco, CA 94103
(415) 431-0640

Byte Shop
321 Pacific Ave.
San Francisco, CA 94111
(415) 421-8686

The Byte Shop
2626 Union Avenue
San Jose, CA 95124
(408) 377-4685

The Computer Room
124H Blossom Hill Rd.
San Jose, CA 95123
(408) 226-8383

The Byte Shop
509 Francisco Blvd.
San Rafael, CA 94901
(415) 457-9311

The Byte Shop
3400 El Camino Real
Santa Clara, CA 95051
(408) 249-4221

Recreational Computer
Centers
1324 South Mary Ave.
Sunnyvale, CA 94087
(408) 735-7480

Byte Shop of Tarzana
18423 Ventura Blvd.
Tarzana, CA 91356
(213) 343-3919

Computer Components
5848 Sepulveda Blvd.
Van Nuys, CA 91411
(213) 786-7411

The Byte Shop
2989 North Main St.
Walnut Creek, CA 94596
(415) 933-6252

Byte Shop
14300 Beach Blvd.
Westminster, CA 92683
(714) 894-9131

COLORADO

Byte Shop
3101 Walnut St.
Boulder, CO 80301
(303) 449-6233

Byte Shop
3464 S. Acoma St.
Englewood, CO 80110
(303) 761-6232

FLORIDA

Byte Shop of
Fort Lauderdale
1044 East Oakland Park
Blvd.
Ft. Lauderdale, FL 33334
(305) 561-2983

Byte Shop of Miami
7825 Bird Road
Miami, FL 33155
(305) 264-2983

Microcomputer
Systems Inc.
144 So. Dale Mabry Hwy.
Tampa, FL 33609
(813) 879-4301

GEORGIA

Atlanta Computer Mart
5091-B Buford Hwy.
Atlanta, GA 30340
(404) 455-0647

ILLINOIS

Champaign Computer
Company
318 N. Neil Street
Champaign, IL 61820
(217) 359-5883

itty bitty machine co.
1322 Chicago Ave.
Evanston, IL 60201
(312) 328-6800

itty bitty machine co.
42 West Roosevelt
Lombard, IL 60148
(312) 620-5808

INDIANA

The Data Domain
406 So. College Ave.
Bloomington, IN 47401
(812) 334-3607

The Byte Shop
5947 East 82nd St.
Indianapolis, IN 46250
(317) 842-2983

The Data Domain
7027 N. Michigan Rd.
Indianapolis, IN 46268
(317) 251-3139

IOWA

The Computer Store
of Davenport
4128 Brady Street
Davenport, IA 52806
(319) 386-3330

KENTUCKY

The Data Domain
3028 Hunsinger Lane
Louisville, KY 40220
(502) 456-5242

MICHIGAN

The Computer Store
of Ann Arbor
310 East Washington
Ann Arbor, MI 48104
(313) 995-7616

Computer Mart
of Royal Oak
1800 W. 14 Mile Rd.
Royal Oak, MI 48073
(313) 576-0900

General Computer Store
2011 Livernois
Troy, MI 48084
(313) 362-0022

MINNESOTA

Computer Depot, Inc.
3515 W. 70th St.
Minneapolis, MN 55435
(612) 927-5601

NEW JERSEY

Hoboken Computer Works
No. 20 Hudson Place
Hoboken, NJ 07030
(201) 420-1644

The Computer Mart
of New Jersey
501 Route 27
Iselin, NJ 08830
(201) 283-0600

NEW YORK

The Computer Shoppe
444 Middle Country Rd.
Middle Island, NY 11953
(516) 732-4446

The Computer Mart
of New York
118 Madison Ave.
New York, NY 10001
(212) 686-7923

The Computer Corner
200 Hamilton Ave.
White Plains, NY 10601
(914) 949-3282

NORTH CAROLINA

ROMs 'N' RAMs
Crabtree Valley Mall
Raleigh, NC 27604
(919) 781-0003

OHIO

Byte Shop
2432 Chester Lane
Columbus, OH 43321
(614) 486-7761

Computer Mart of Dayton
2665 S. Dixie Ave.
Dayton, OH 45409
(513) 296-1248

OREGON

Byte Shop Computer Store
3482 SW Cedar Hills Blvd.
Beaverton, OR 97005
(503) 644-2686

The Real Oregon
Computer Co.
205 West 10th Ave.
Eugene, OR 97401
(503) 484-1040

Byte Shop Computer Store
2033 SW 4th Ave.
Portland, OR 97201
(503) 223-3496

RHODE ISLAND

Computer Power, Inc.
M24 Airport Mall
1800 Post Rd.
Warwick, RI 02886
(401) 738-4477

SOUTH CAROLINA

Byte Shop
2018 Green St.
Columbia, SC 29205
(803) 771-7824

TENNESSEE

Microproducts & Systems
2307 E. Center Street
Kingsport, TN 37664
(615) 245-8081

TEXAS

Computer Port
926 N. Collins
Arlington, TX 76011
(817) 469-1502

Computertex
2300 Richmond Ave.
Houston, TX 77006
(713) 526-3456

Interactive Computers
7646½ Dashwood Rd.
Houston, TX 77036
(713) 772-5257

Neighborhood Computer
Store
#20 Terrace
Shopping Center
4902 - 34th Street
Lubbock, TX 79410
(806) 797-1468

The Micro Store
634 So. Central
Expressway
Richardson, TX 75080
(214) 231-1096

VIRGINIA

The Computer Systems
Store
1984 Chain Bridge Rd.
McLean, VA 22101
(703) 821-8333

Media Reactions Inc.
Reston International Center
11800 Sunrise Valley Dr.
Suite #312
Reston, VA 22091
(703) 471-9330

The Home Computer Center
2927 Virginia Beach Blvd.
Virginia Beach, VA 23452
(804) 340-1977

WASHINGTON

Byte Shop Computer Store
14701 N.E. 20th Ave.
Bellevue, WA 98007
(206) 746-0651

The Retail Computer Store
410 N.E. 72nd
Seattle, WA 98115
(206) 524-4101

WISCONSIN

The Milwaukee
Computer Store
6916 W. North Ave.
Milwaukee, WI 53213
(414) 259-9140

WASHINGTON D.C.

Georgetown
Computer Store
3286 M Street NW
Washington, D.C. 20004
(203) 362-2127

CANADA

Trintronics
160 Elgin St.
Place Bell Canada
Ottawa, Ontario K2P 2C4
(613) 236-7767

Computer Mart Ltd.
1543 Bayview Ave.
Toronto, Ontario M1K 4K4
(416) 484-9708

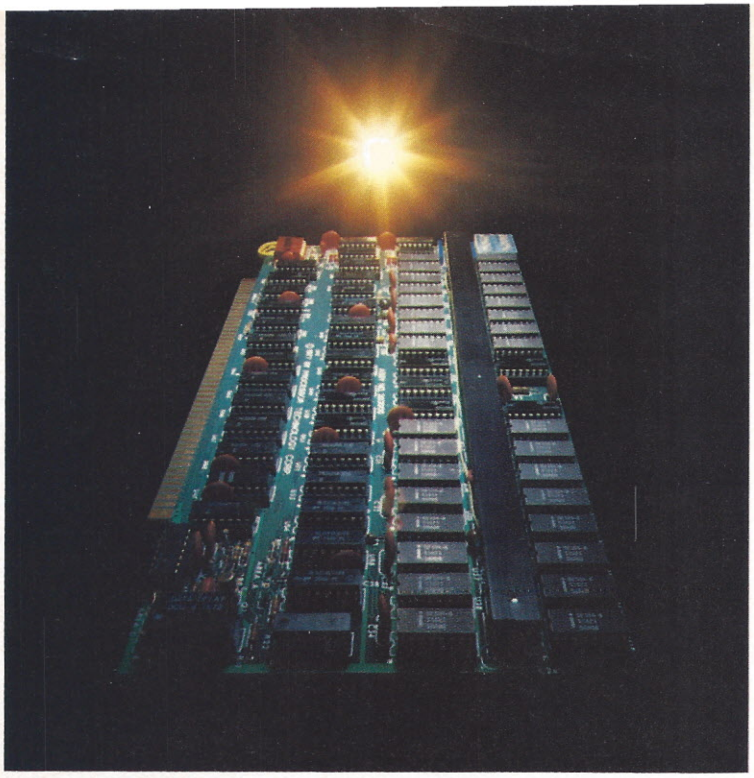
First Canadian
Computer Store Ltd.
44 Eglinton Ave. West
Toronto, Ontario M4R 1A1
(416) 482-8080

The Computer Place
186 Queen St. West
Toronto, Ontario M5V 1Z1
(416) 598-0262

Basic Computer Group Ltd.
1548 East 8th Ave.
Vancouver, B.C. V6J 4R8
(604) 736-7474

Pacific Computer Store
4509 Rupert St.
Vancouver, B.C. V5R 2J4
(604) 438-3282

ProcessorTechnology



The end of Kit-Kits.

The end of bad solder joints, heat damaged components and sick IC's. Introducing the Semikit. Item 1, a 16KRA Memory Board, $369.

Let's face it. Loading and soldering PC Boards is not much fun for the kit builder. Even more important, it's the place where most of the trouble gets introduced. The real fun and education comes in running and testing boards.

Now the Semikit with fully tested IC's.

At the price of a kit, Processor Technology Corporation introduces the Semikit. It's a fully stuffed, assembled and wave soldered PC Board loaded with IC's that have gone through Q.C. and final check-out (a first in the industry).

We leave you the fun of testing with our fully documented set of instructions. We do the production tasks of loading, wave soldering and inspecting the boards. You do the more interesting and time consuming chore of testing and burning-in the boards.

The result is one sweet deal for both of us. You get a board where the primary causes of damage (poor solder joints, excess solder and bad IC's) are virtually eliminated. You get a board of highest professional quality. And we get the business!

The 16KRA Memory Board's at your dealer now.

Your Processor Technology dealer has the first Semikit, a 16KRA Memory Board, in stock and ready to go right now. You can take it home tonight for $369 as a Semikit or for $399 fully assembled, tested and burned-in.

You'll have a 16,384 byte memory with a better price performance ratio than anything on the market today. Now you can afford to add quality, high density memory to your system for remarkably little. And you can add enough to solve complex computing problems right in the main frame.

The memory features invisible refresh. There's no waiting while the CPU is running. Worst case access time is 400 nsec. Each 4,096 word block is independently addressable for maximum system flexibility. Power is typically 5 watts, the same as most single 4K memory modules. Back-up power connection is built-in.

Other Semi's are coming your way.

The 16KRA Memory is Processor's first step in adding more fun, capability and reliability to your computer system at lower cost. Other modules are on the way to your dealer now. Come on down today.

Or you may contact us directly. Please address Processor Technology Corporation, Box L, 7100 Johnson Industrial Drive, Pleasanton, California 94566. Phone (415) 829-2600.

Processor Technology

CIRCLE 37

The departure of Ed Roberts from the personal computing scene marks the end of an era in the development of this industry. The price of entry into the market has increased to the point that the small entrepreneur has less chance to make it, particularly if he wants to manufacture hardware. It's the big boys' turn now.

Recently, I was talking to Ed Currie, who is in charge of product development at Mits/Pertec, and he was lamenting that Roberts hasn't received the recognition he deserves for starting the personal computing industry. A lot of us insiders have either indirectly or directly benefited from the great pioneering spirit that Roberts brought to this game, to say nothing of the genius of his engineering and marketing concepts.

Roberts is living proof that someone with a good idea and the will power to carry it through can still "make it" in this country and that has to be encouraging to all of us. When I joined the staff at Mits as a technical writer in August of 1972 at a salary of $115 a week, it was only a stop-gap measure, something to occupy my time while I looked for better work. Mits was a grimy little electronics company. I shared a 10 by 10 office with two other people and I remember that the air conditioning was so primitive that the first thing we did every morning was clean the fine layer of dust that had settled on our work during the night.

In spite of the working conditions and the low pay, there was a fascination about Mits that was hard not to get caught up in. It was the spirit of pioneering in technology that was not unlike what the early settlers in the West must have felt. We weren't going to be satisfied with mere business success, we wanted to do things that people had never done before and we wanted to do them well. Long before Mits received recognition as the "IBM of the industry,"

The Last Word

there was plenty of talk around the place about taking "big brother" on and beating him at his own game. Perhaps naivete was our greatest asset.

When I think about it, it was Roberts personally who created this spirit at Mits which has spilled over throughout the whole personal computing industry. He is, in my opinion, a great man, and I am privileged to have been touched by him.

When Roberts told me that he was leaving Pertec to buy a farm in Georgia and to experiment around with solar energy and other things (most likely, robotics), he said he was leaving the industry never to be heard from again. I said, "Bull!", Roberts will be heard from again. The temptation will be too great for him to resist.

PERSONAL COMPUTING is truly privileged to be carrying the two-part interview with Ed Roberts that begins in this issue. It is, in a sense, his parting shot and I think most of our readers will be fascinated by what he has to say.

David Bunnell

Publisher

YES YOU CAN

Put The VERSATILE 2 To Work Now!

Even if you've NEVER used a computer, you can begin to operate the VERSATILE 2 immediately.
It's all been done for you: a compact computer that needs no extras, and a complete software library.

Great for HOBBYISTS • TEACHERS • BUSINESSMEN

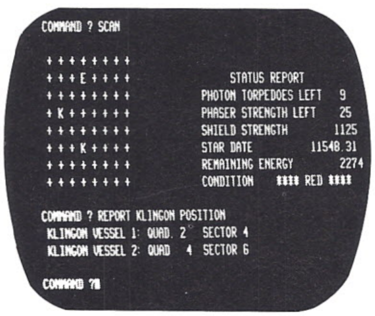
HOME You don't have to be a programmer or electronics technician. Or know anything more than how to plug it in, and read our manual. Get your hobby going without hassle.

CLASSROOM Get your kids right to work learning BASIC, playing games and solving math and accounting problems without worrying about what makes the computer go.

OFFICE Stop drowning in paperwork. And quit worrying about which system will work best for you. With our business accounting package, you can concentrate on business while the VERSATILE 2 concentrates on maintaining your records compactly, and permanently on diskette.

Shugart Mini-Floppy Disk Drive and Controller built into the VERSATILE 2

Numeric Keypad may be ordered as option at no charge.



SPECIFICATIONS
Z-80 CPU
Video display with graphics on 9" 64x16 screen
16K Static RAM Memory
Serial and Parallel I/O Ports with standard RS-232 Connector provided at rear of unit
ROM to drive RS-232

EXPANDABLE
Add memory, printer, and up to 3 external mini-floppy disk drives.

OPTIONS
8K Memory Boards at $195.00 each.

HOME SOFTWARE LIBRARY

Five diskettes are included to give you immediate programming capabilities.

DISK #1 contains a Disk Operating System and 12K Extended BASIC. Easy to use statements include: IF THEN, GOTO, READ, EXIT, FOR, NEXT. You get complete line editor, multi-statement lines and multi-dimension arrays. A BASIC teaching program on this diskette will have you quickly programming in BASIC.

DISK #2 has many games including STAR-TREK, BLACKJACK and STAR WARS. There's room left over for you to add your own.

DISK #3 is a Home Accounting Package with programs like Budgeting, and Checkbook Balancing.

DISK #4 contains a Small Business Accounting Package. Included are programs for Payroll, Inventory Control, Accounts Payable and Receivable, Taxes, Invoicing, Check Printing, and much more.

DISK #5 is a formatted blank diskette for you to enter your own programs.

VERSATILE 2

$2495 Assembled and Tested. 6 Month Warranty. 30-day delivery or available direct from dealers.

Scientific Sales, Inc.
175 W. Wieuca, Suite 210
Atlanta, GA 30342
(404) 252-6808

COMPUTER DATA SYSTEMS
5460 Fairmont Drive
Wilmington, Delaware 19808
(302) 738-0933

Alexander and Company, Inc.
5518 Florin Road
Sacramento, CA 95823
(916) 422-9070

CIRCLE 2

Your computer system needn't cost a fortune.

Some computer kits include little more than a mother board and a front panel, and you pay extra for everything else you need to make an operating computer.

SWTPC doesn't do it that way, so you can get your Southwest Technical 6800 Computer up and running at a bargain cost compared with most other systems. It comes complete at $395 with features that cost you extra with many other systems.

The Extras You Get

These extras include 4K of random-access memory, a mini-operating system in read-only memory, and a serial control interface. They give you 1) a considerable amount of working memory for your programs, 2) capability through the mini-operating system to simply turn on power and enter programs without having to first load in a bootstrap loader, and 3) an interface for connecting a terminal and beginning to talk with your computer immediately.

Low-Cost Add-Ons

Now that you have a working computer, you'll probably want to add at least two features soon, more memory and interfaces for needed accessory equipment. Memory for our 6800 is another bargain. You can get 4K memory boards for just $100 and 8K boards for only $250.

Our interfaces cost little compared with many other systems. For just $35 you can add either a serial or parallel interface board. (And you won't have to buy several interfaces on a costly board to get just the one you want.)

Peripheral Bargains

Your computer is no good without at least a terminal for entering data and viewing computer output, and you will probably want a good method of storing programs and data.

We offer you a line of high-quality peripherals at low prices. (You can prove this by just comparing prices.)

Buy our CT-64 Video Terminal for only $325 and our CT-VM Monitor with matching cover for $175. Our MF-68 Dual Minifloppy costs just $995, complete with Disk BASIC and a disk operating system. For cassette storage our AC-30 Cassette Interface gives simple control for one or two cassette recorders.

You can get inexpensive hard copy with our PR-40 Alphanumeric Line Printer.

We back up the 6800 system with low-cost software, including 4K and 8K BASIC.

Compare the value you get with our computer and peripherals before you buy. We think you'll find that SWTPC gives you more for your money in every way.

Enclosed is:

_____ $995 for the Dual Minifloppy
_____ $325 for the CT-64 Terminal
_____ $175 for the CT-VM Monitor
_____ $395 for the 4K 6800 Computer
_____ $250 for the PR-40 Line Printer
_____ $79.50 for AC-30 Cassette Inferface
_____ Or BAC # _____ Exp. Date _____
Or MC # _____ Exp. Date _____

Name
Address

Southwest Technical Products Corp.
219 W. Rhapsody, San Antonio, Texas 78216
London: Southwest Technical Products Co., Ltd.
Tokyo: Southwest Technical Products Corp./Japan